MAR 14 1913

Engineering News

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NEW YORK, MARCH 13, 1913

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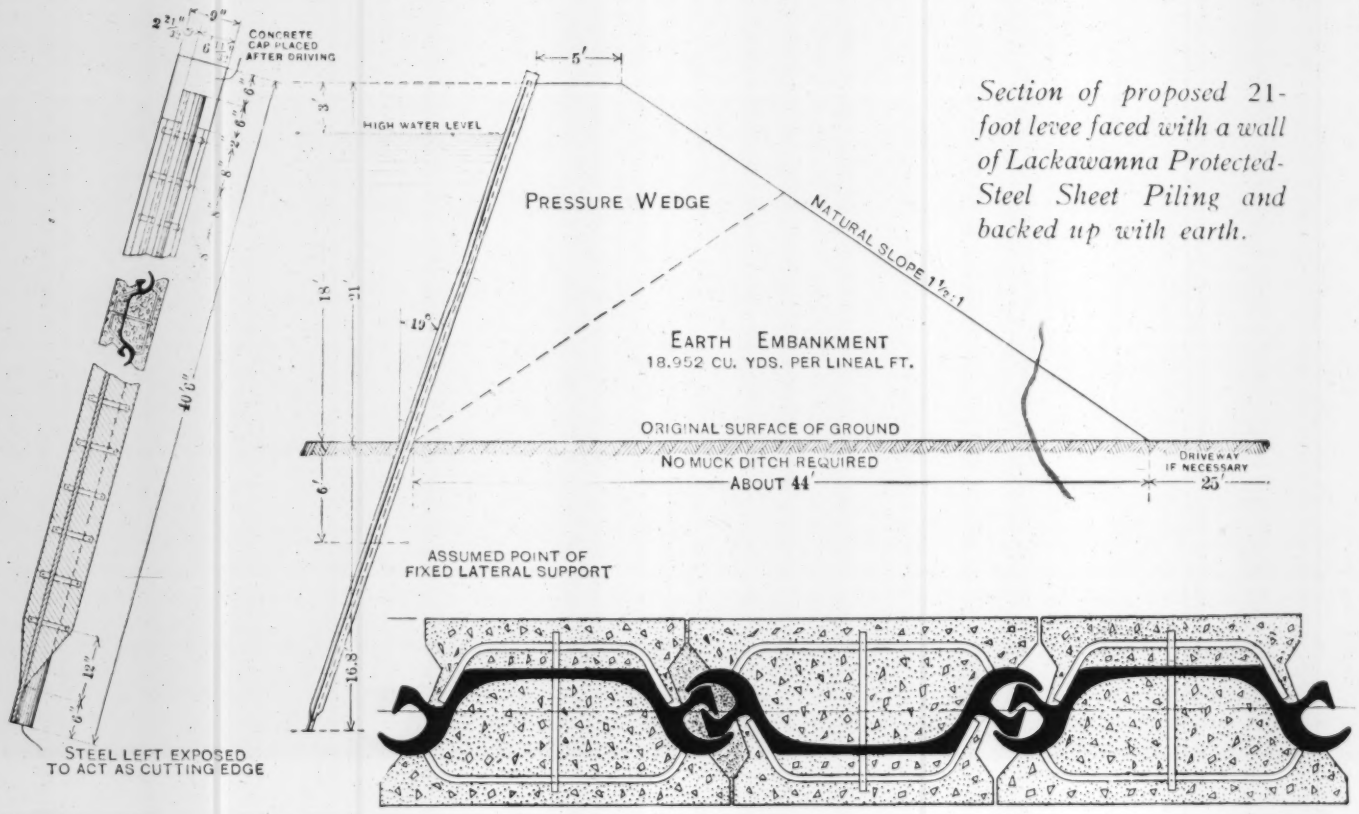

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Engineering News

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Number Eleven

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Engineering News

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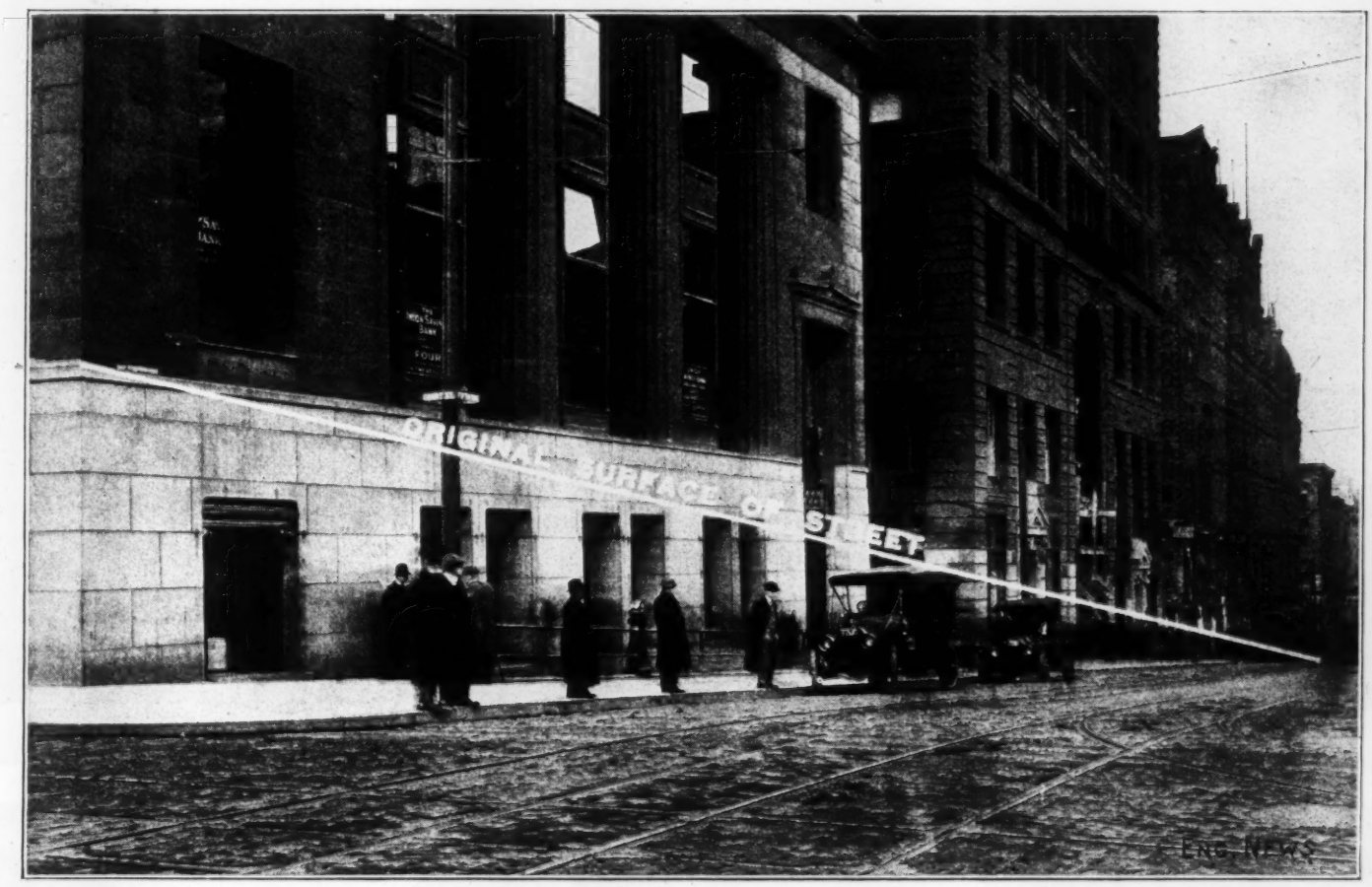
An Example of Street Grade Improvement

The Pittsburgh "Hump Cut," described in ENGINEERING NEWS of Jan. 11 and Sept. 26, 1912, is carried on in two sections, the contract requiring the first section to be completed before the second section is begun. The first section, which comprises the work in the principal streets, was practically completed by the end of 1912. The view herewith shows the effect of the work on the principal street involved, the block in Fifth Ave. between Smithfield and Grant Sts. The white sloping line drawn on the picture is intended to represent the line of the street surface at the south building line before the hump cut was begun. The improvement in gradient is obvious. The steep slope of Fourth, Fifth and Sixth Aves., east of Smithfield St., has hitherto acted as a bar to the eastward expansion of the congested business district.

The hump cut involved extensive building changes, as we have already noted in our previous articles. One of the simplest items was the reconstruction of the basement stories of several important buildings, such as the Frick Bldg., shown in the left foreground of the view. This structure had been originally planned to be adaptable to an ultimate reduction of grade, and therefore the construction of a facade in the basement story was a relatively simple matter. The Carnegie Bldg., just beyond, also offered a not difficult problem, although the smaller amount of cut at that building made the adjustment less convenient.

The cost of the changes in buildings was evidently a very large item, much larger than the cost of the street work itself. That the city could undertake the hump-cut improvement at all was due only to the fact that by far the largest number of property interests affected by the change waived claims for damages, before work was undertaken. What this means will be appreciated to a small extent from the statement that the cost of the changes in the Frick Bldg. was about $100,000. The street frontage of this building represents less than 3% of the total street frontage affected by the cut. Much of the hump-cut frontage was occupied by old and low-grade buildings, which were not worth the cost of alteration. The district will, therefore, be in large part rebuilt.



VIEW WEST ON FIFTH AVE. FROM GRANT ST. TOWARD SMITHFIELD ST., PITTSBURGH, SHOWING RESULT OF THE "HUMP CUT"

Windbracing without Diagonals for Steel-frame Office-buildings

By R. Fleming*

If an apology is needed for adding to the literature of the above subject, it may be found in the fact that many of the methods given in technical papers for determining stresses due to wind loadings are not *workable*. That is, the average engineer to whom falls the lot of designing the average office-building has neither the time nor the ability to handle the cumbersome equations involved. One paper published a few years ago and now before the writer has for its purpose "to develop the exact theory of framework with rectangular panels, and then to suggest such short-cuts as may be of use in actual designing." This is an elaborate paper in which the theorem of four moments is used. A bent of two unequal bays, three columns and two girders, is considered and by the "short-cuts" seven equations are found from which the values of all the moments for the floor in question may be found. Whatever may be the merit of this and similar papers, it has not been recognized sufficiently to be followed to any appreciable extent. It is to be regretted that the treatment of the subject in our textbooks is not more complete and adequate.

Buildings like the Trinity, the Fuller, the Singer, the Woolworth, or the Metropolitan Tower, in New York City, are each in a class by itself, and of necessity careful study is given to the windbracing. For another and a large class of office-buildings, little or no attention is given to the matter of bracing for wind, either in the proportioning of main members or in the equally important matter of details.

Without further introduction the writer gives three methods in current use of calculating wind stresses and moments in office-buildings where diagonals are not permissible. Each method has its own advocates.

Considering a single bent: It will be assumed that all columns in any given story have the same sectional area and the same section modulus, that all girders of the same floor have the same section modulus, and that the joints are perfectly rigid. It is obvious that if the forces in the several members of the frame are small in relation to the stiffness of the members, the longitudinal distortions may be neglected; hence the adjacent joints occupying the corners of a rectangle will after distortion occupy the corners of an oblique parallelogram.

It is assumed that the point of contraflexure of each column is at midheight of the story. The first method described further involves the tacit assumption that the girders have their points of contraflexure at midlength. Specific assumptions as to the distribution of column shears and direct stresses are made in the several methods. In no one of the three methods are the assumptions strictly consistent. For example, in Method I the assumption as to location of points of contraflexure would make the distorted shape of panel constant in any given story, and from this would follow that the column shears must be equal; but the calculation gives column shears of different amount.

The resistance to overturning will cause a direct stress in tension on the windward side of the neutral axis, taken by all or some of the columns on that side according to the method used, and a direct stress in compression on the leeward side taken by the columns on that side.

Figs. 1, 7 and 9 give results obtained from calculations according to Methods I, II and III respectively. Loads and stresses are given in thousands of pounds and bending moments in thousands of foot-pounds. Direct stresses are given in parentheses ( ).

Method I

This is a restatement with some modifications of an article entitled "Windbracing with Kneebraces or Gusset-plates," by A. C. Wilson, in *The Engineering Record*, Sept. 5, 1908. A section or bent of the building is considered similar to a beam loaded as a cantilever.

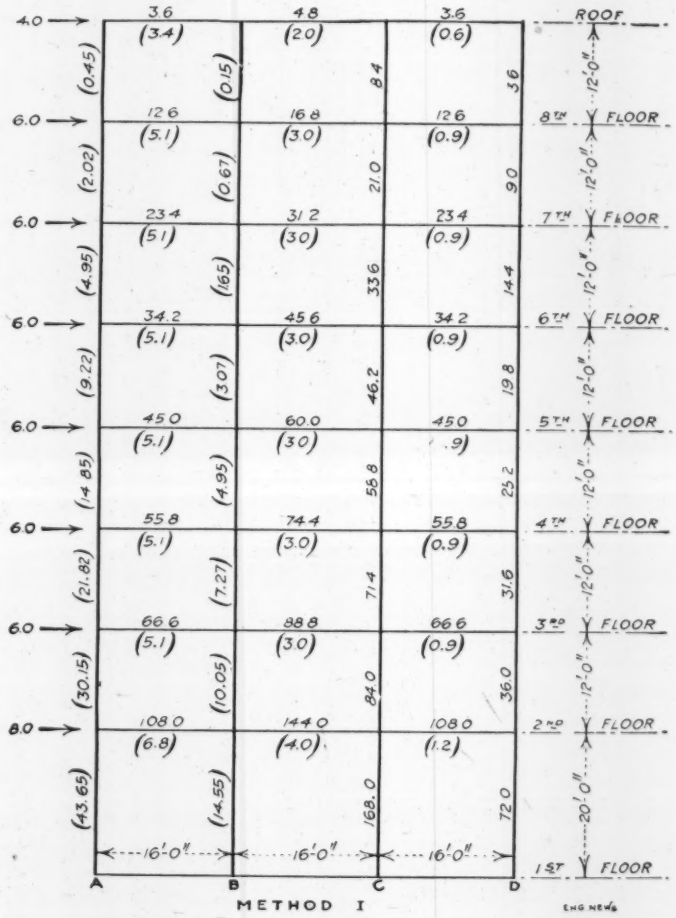


Fig. 1. Rectangular Building-frame: Direct and Bending Stresses Calculated by Approximate Method I

144.0 = Moment of 144,000 ft.-lb.
(4.0) = Direct stress of 4000 lb.

If a beam of rectangular section be loaded as a cantilever with concentrated loads, it is possible by the theory of flexure to find the internal stresses at any point. If, however, rectangles be cut out of the beam between the loads, there will then be a different condition of stress. What was the horizontal shear of the beam will now be a shear at the point of the contraflexure of the floor girders, causing bending, and, as in the beam, the nearer the neutral axis the greater the shear. The vertical shear in the beam would be taken up by the columns as a shear at the points of contraflexure and the amount of this shear taken by each column would, as in the beam, increase toward the neutral axis. The direct stresses of tension or compression in the beam would act on the columns as a direct load of either tension or compression, and as in the beam would decrease toward the neutral axis.

Each intersection of column with floor girders would be held in equilibrium by forces acting at the points of contra-

*Designing Engineer, American Bridge Co., 30 Church St., New York City.

flexure; and to find all the forces acting around a joint at any floor the bending moments of the building at the points of contraflexure of the columns above and below the floor in question are found as will be explained later.

It is assumed that if a beam of constant, symmetrical cross-section and homogeneous material is fixed at both ends, and that if forces tend to move those ends from a position

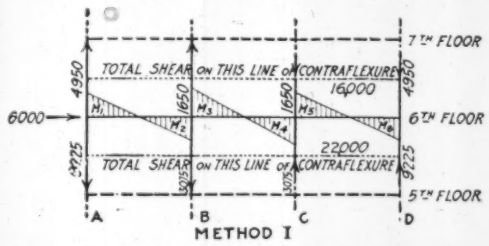


FIG. 2. COLUMN SHEARS AND GIRDER MOMENTS AT SIXTH FLOOR, CALCULATED BY METHOD I

in the same straight line to a position to one side with the ends still parallel, reversed bending will occur with the point of contraflexure in the center of the unsupported span. And since this condition exists in all columns and floor girders it will be necessary to find the shears at the points of contraflexure as well as the direct stresses in all members.

Fig. 1 gives stresses and maximum moments in all members of a section of the building in accordance with the above statement.

The calculation of stresses and bending moments in members about the sixth floor will be given in detail. The direct stress in any column is assumed to be proportional to its distance from the neutral axis of the cross-section of the building. In the cross-section considered, the neutral axis coincides with the center line of the building. The total moment of the wind loads above the sixth floor about the line of inflection of the sixth-story columns must equal the moment of the direct stresses in these columns about the neutral axis. Let $8X$ be the direct stress in each of the sixth-story columns B and C, then $24X$ will be the direct stress in each of the sixth-story columns A and D. Hence we have

$$(4000 \times 30) + (6000 \times 18) + (6000 \times 6) = (24X \times 24) + (8X \times 8) + (8X \times 8) + (24X \times 24)$$

From which $8X = 1650$ and $24X = 4950$.

In the same way for the fifth-story columns we have the equation

$$(4000 \times 42) + [6000 \times (30 + 18 + 6)] = [(24X \times 24) + (8X \times 8)] \times 2$$

From which $8X = 3075$, the direct stress in the fifth-story columns B and C; and $24X = 9225$, the direct stress in the fifth-story columns A and D.

The total horizontal shear on any line across the building is the sum of the wind loads above that line. The shear taken by any column in any story is proportional to the total horizontal shear in that story.

In Fig. 2, if X = shear of any fifth-story column at its point of inflection, then $\frac{16,000}{22,000} X$ or $\frac{8}{11} X$ = shear at point of inflection of the sixth-story length of the same column, and $\frac{6,000}{22,000} X$ or $\frac{3}{11} X$ = increment of shear taken by the column at the floor girder.

We are now ready to consider the forces about the first joint, or the intersection of Col. A with the sixth-floor girder, sketched separately as Fig. 3.

The difference between 9225 and 4950 = 4275 is taken up as a shear in the floor girder between Cols. A and B. The moments of the shears must hold the joint in equilibrium. Taking moments about the lower point of inflection we have

$$({}^{8}_{11}X \times 12) + ({}^{3}_{11}X \times 6) = 4275 \times 8$$

from which $X = 3300$, ${}^{8}_{11}X = 2400$ and ${}^{3}_{11}X = 900$. The bending moment $M1$ for the floor girder is $4275 \times 8 = 34,200$ ft.-lb. The bending moment for the fifth-story column is $3300 \times 6 = 19,800$ ft.-lb., and that for the sixth-story column is $2400 \times 6 = 14,400$ ft.-lb. The direct thrust on the floor girder is $6000 - 900 = 5100$.

Proceeding to the second joint, sketched in Fig. 4: The difference between 3075 and 1650 = 1425 acts as a shear in the girder between Cols. B and C. This added to the 4275 shear continued from the girder between A and B makes a total shear of 5700 in the girder. The equation of moments is

$$({}^{8}_{11}X \times 12) + ({}^{3}_{11}X \times 6) = (4275 \times 8) + (5700 \times 8)$$

From which $X = 7700$; ${}^{8}_{11}X = 5600$, and ${}^{3}_{11}X = 2100$, are the shears taken by Col. B to hold the joint in equilibrium.

The bending moment $M2$ of the girder from A to B at Col. B is the same as at Col. A with an opposite sign; $M3$, of the girder from B to C, is $5700 \times 8 = 45,600$ ft.-lb. The bending moment of the fifth-story column is $7700 \times 6 = 46,200$ ft.-lb., and that of the sixth-story column is $5600 \times 6 = 33,600$ ft.-lb. The direct thrust on the girder between B and C is $5100 - 2100 = 3000$.

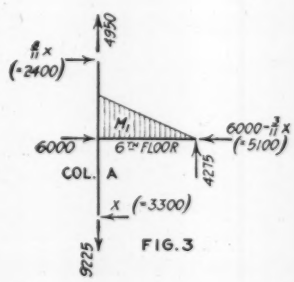
At the third joint, Fig. 5, the shear taken by the girder between C and D is $5700 - (3075 - 1650) = 4275$. From the equation of moments

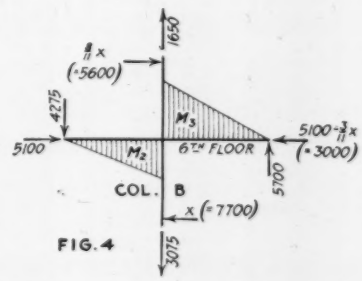
$$({}^{8}_{11}X \times 12) + ({}^{3}_{11}X \times 6) = (5700 \times 8) + (4275 \times 8)$$

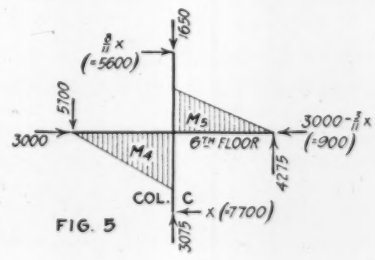
whence

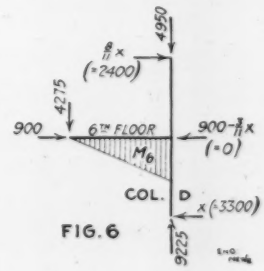
$$X = 7700,\ {}^{8}_{11}X = 5600,\ {}^{3}_{11}X = 2100$$

As expected, the moments in Col. C are numerically equal









FIGS. 3-6. SIXTH-FLOOR JOINTS OF BUILDING-FRAME, WITH STRESSES CORRESPONDING TO METHOD I

to those in Col. B, and the girder moments $M4 = M3$, and $M5 = M2$. The compression in the floor girder between C and D is $3000 - 2100 = 900$.

At the fourth joint, Fig. 6, we have

$$({}^{8}_{11}X \times 12) + ({}^{3}_{11}X \times 6) = (4275 \times 8)$$

the same equation as at the first joint, and hence the same numerical values for moments and shears.

The designer in following this method for the various floors will find many short-cuts. A relationship between the floors can soon be established. If the distances between columns are not even spaces, or the columns have different sectional areas, the direct stresses vary both in proportion to their distances from the neutral axis and their sectional areas. It will be necessary to first find the neutral axis of the cross-section in question and then the direct stresses. With these the shears and bending moments can be obtained.

Method II

This may be called the Portal Method. It is assumed that the horizontal shear on any plane is equally distributed among the columns cut by that plane. The

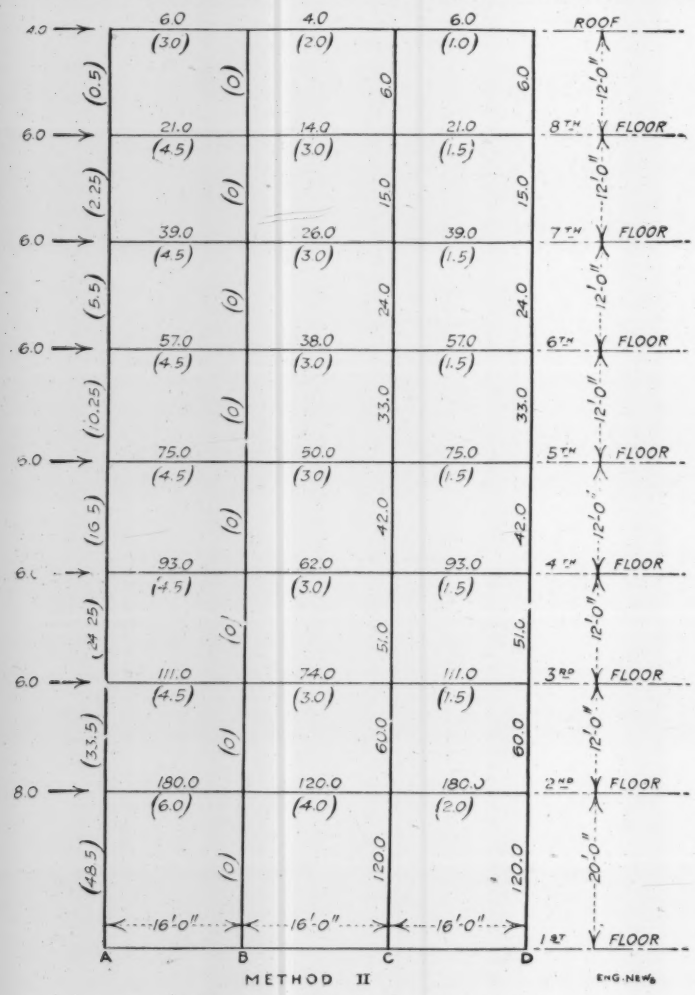


Fig. 7. Rectangular Building-frame: Direct and Bending Stresses Calculated by Approximate Method II

120.0 = Bending moment of 120,000 ft.-lb.
(4.0) = Direct stress of 4000 lb.

structure is also regarded as equivalent to a series of independent portals. The stresses and maximum bending moments for a cross-section of the building are as given in Fig. 7.

Taking any aisle we find the direct stress in the fifth-story columns to be

$$\left(\frac{4000}{3} \times 42\right) + \left(\frac{6000}{3} \times 30\right) + \left(\frac{6000}{3} \times 18\right) + \left(\frac{6000}{3} \times 6\right) \text{ divided by } 16 = 10{,}250$$

The direct stresses coming upon any interior column

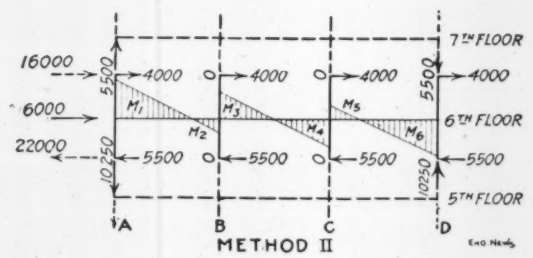


Fig. 8. Column-shears and Girder Moments at Sixth Floor, Calculated by Method II

from the adjacent aisles are equal in amount but opposite in direction. Hence their algebraic sum is zero and only the outside columns have direct stresses. This may be found directly for any story, say the sixth,

$$(4000 \times 30) + (6000 \times 18) + (6000 \times 6)$$
$$\text{divided by } 48 = 5500$$

Considering in detail, as in Method I, the sixth floor, we have in Fig. 8 the direct stresses and shears in the columns.

The shear in each girder is 10,250 — 5500 = 4750. The equations for bending moments in the girders can be written as follows:

M1 = [(4000×6) +(5500×6)] = +57,000 ft.-lb.
M2 = [(4000×6) +(5500×6)]—[(10,250—5500) ×16] = —19,000 ft.-lb.
M3 = [2(4000×6) +(5500×6)]—[(10,250—5500) ×16] = +38,000 ft.-lb.
M4 = [2(4000×6) +(5500×6)]—[(10,250—5500) ×32] = —38,000 ft.-lb.
M5 = [3(4000×6) +(5500×6)]—[(10,250—5500) ×32] = +19,000 ft.-lb.
M6 = [3(4000×6) +(5500×6)]—[(10,250—5500) ×48] = —57,000 ft.-lb.

The bending moment at the sixth-floor girder of each sixth-story column is 4000 × 6 = 24,000 ft.-lb., and of each fifth-story column is 5500 × 6 = 33,000 ft.-lb.

The compression in the floor girders is 6000 — 1500 = 4500 between Cols. *A* and *B*, 4500 — 1500 = 3000 between *B* and *C*, and 3000 — 1500 = 1500 between *C* and *D*. General equations can easily be deduced which will simplify the calculation of stresses and moments for other floors. If the spaces between columns are unequal, the direct stresses from adjacent portals will be unequal. This difference is a direct stress in the column between the two portals considered. If the columns have different section moduli, the horizontal shear taken by each column will be in proportion to its section modulus.

An interesting special case of this method is for buildings having self-supporting walls or where the outer columns carry floor loads only. For even spacing the exterior columns will carry only half the floor load of the interior columns. Assuming the section modulus of the column in the outer row to be one-half of that in the interior, the bending moments due to wind for all girders on the same floor for any transverse bent will be alike and the bending moments of the interior columns will be twice that of the outer columns. This is an ideal condition for the designer, the detailer, and the shop.

Method III

This may be called the Continuous Portal Method. The direct stresses in the columns are assumed to vary as their distances from the neutral axis, and the horizontal shear on any plane is equally distributed among the columns cut by that plane. Stresses and maximum bending moments for a cross-section of the building are as given in Fig. 9.

The direct stresses in the columns are found the same way and are the same in amount as in Method I.

Considering in detail the sixth floor, we have in Fig. 10 the direct stresses and shears in the columns. The

shear in the girder A to B and the girder C to D is 9225 — 4950 = 4275. The shear in the girder B to C is (9225 — 4950) + (3075 — 1650) = 5700.

The equations for bending moments in the girders can be written as follows:

M1 = [(4000 × 6) + (5500 × 6) = +57,000 ft.-lb.
M2 = [(4000 × 6) + (5500 × 6)] — [(9225—4950) × 16] = —11,400 ft.-lb.
M3 = 2[(4000 × 6) + (5500 × 6)] — [(9225—4950) × 16] = +45,600 ft.-lb.
M4 = 2[(4000 × 6) + (5500 × 6)] — [(9225—4950) × 32] — [(3075—1650) × 16] = —45,600 ft.-lb.
M5 = 3[(4000 × 6) + (5500 × 6)] — [(9225—4950) × 32] — [(3075—1650) × 16] = +11,400 ft.-lb.
M6 = 3[(4000 × 6) + (5500 × 6)] — [(9225—4950) × 48] — [(3075—1650) × 32] + [(3075—1650) × 16] = —57,000 ft.-lb.

The bending moment at the sixth-floor girder of each sixth-story column is 4000 × 6 = 24,000 ft.-lb., and of each fifth-story column is 5500 × 6 = 33,000 ft.-lb. The compression in the floor girders is 6000 — 1500 = 4500 lb. between Cols. A and B, 4500 — 1500 = 3000

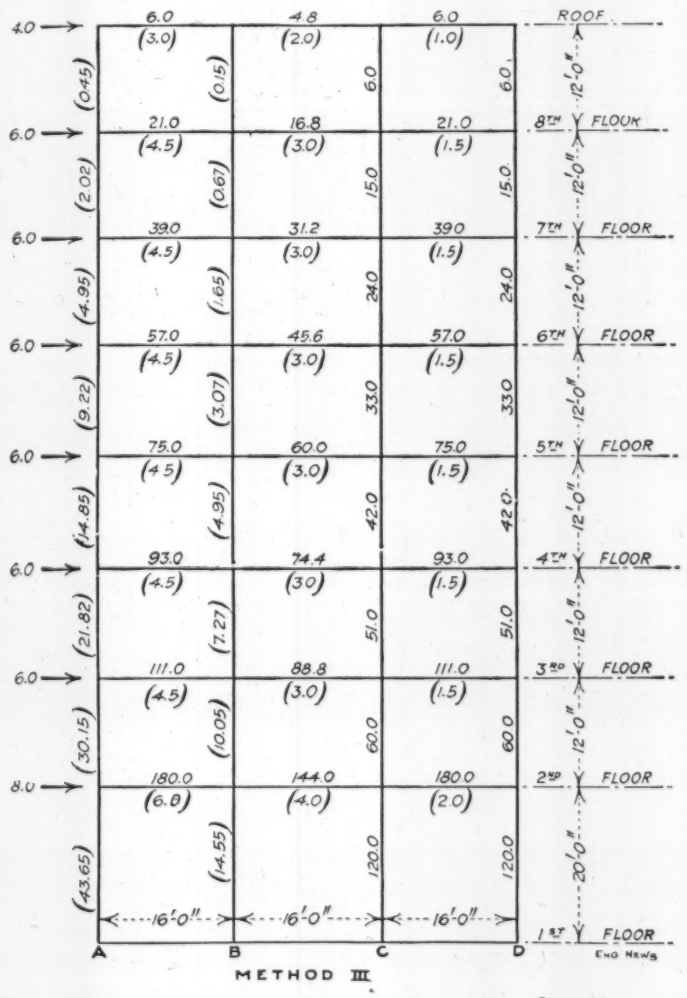


FIG. 9. RECTANGULAR BUILDING-FRAME: DIRECT AND BENDING STRESSES CALCULATED BY APPROXIMATE METHOD III

144.0 = Bending moment of 144,000 ft.-lb.
(4.0) = Direct stress of 4000 lb.

between B and C, and 3000 — 1500 = 1500 between C and D.

If the columns are unequally spaced or their sectional areas are different, the location of the neutral axis must first be found. The direct stresses in the columns will vary both as their distances from the neutral axis and their sectional areas. The horizontal shears taken by the columns will vary as their section moduli.

CONCLUSION

It can be said of each of the above three methods of calculating wind stresses that it is easily workable; and, to quote Prof. W. H. Burr: "So long as the stresses

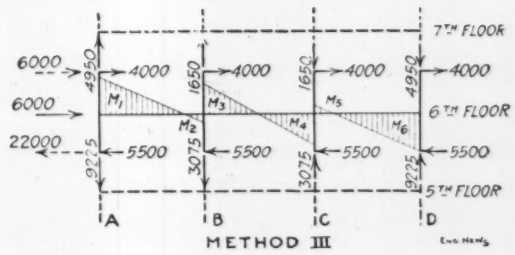


FIG. 10. COLUMN-SHEARS AND GIRDER MOMENTS AT SIXTH FLOOR, CALCULATED BY METHOD III

found by one legitimate method of analysis are provided for, the stability of the structure is assured." At the present time Method I is probably more used than either II or III. It has been followed in designing a number of important buildings in New York City and elsewhere. Method II has been used quite extensively and Method III to a limited extent. The writer personally prefers Method I, though during the past ten years he has used both I and II.

It is often convenient to assume the wind loads on the basis of using the same unit-stresses as for live- and dead-loads. The Building Code of the City of New York calls for a horizontal wind pressure of 30 lb. per sq.ft. and allows working stresses to be increased 50% for windbracing. A wind load of 30 lb. per sq.ft. with unit-stresses of 24,000 lb. per sq.in. is equivalent to a load of 20 lb. per sq.ft. with a unit-stress of 16,000 lb. per sq.in.—the working stress generally used for live- and dead-loads. The diagrams of moments for any floor girder can easily be combined in one figure (see Fig. 11), and the total moment at any point read by scaling.

Some engineers neglect the wind stresses when the combined stresses, due to live-, dead- and wind-loads, do not increase by 50% the stresses due to live- and dead-loads alone.

Special attention should be given the column splices, and the connections of floor girders to columns. It is folly to add material to columns or floor girders to meet stresses and moments due to wind and then neglect their connections. Care should be taken that in all cases the connections are made strong enough for the bending moments coming upon them.

It is also advisable to calculate the building for wind in a longitudinal direction as well as transversely, a simple thing to do but which in some marked cases has been neglected.

ADDENDUM

The wind loads and working stresses to be used are seldom left to the choice of the designer, being generally fixed by the building code of the city in which the building is located. The Building Code of the City of New York is mentioned above. The codes of Rochester, Jersey

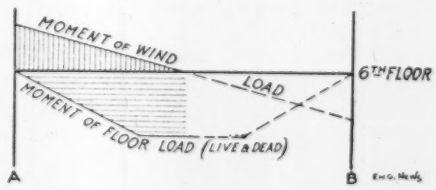


FIG. 11. GRAPHICAL COMBINATION OF MOMENTS FROM VERTICAL LOADS AND WIND LOADS IN FLOOR GIRDER

City, Minneapolis, Atlanta and a number of other cities follow that of New York regarding wind pressure. Baltimore and Buffalo each specify a horizontal wind pressure of 30 lb. per sq.ft. and use the same working stresses for all loads. The Philadelphia law requires a provision for wind pressure of 30 lb. per sq.ft. on buildings in open spaces and on wharves. For high buildings in built-up districts the pressure specified is from 35 lb. per sq.ft. at the fourteenth story and above to 25 lb. at the tenth story and below. Working stresses may be increased 30% for wind loads. Chicago and San Francisco specify a horizontal wind pressure of 20 lb. per sq.ft. and allow an increase of 50% in working stresses for wind loads. The St. Louis building law has the provision: "Where there are buildings immediately adjoining, the wall surface covered by such buildings will be considered as not exposed to wind pressure." The building law of Boston has for its only requirement regarding wind the single sentence: "Provision for windbracing shall be made wherever it is necessary."

C. C. Schneider, in his "General Specifications for Structural Work of Buildings," calls for a wind load of 20 lb. per sq.ft. on the sides and ends of buildings and on the vertical projection of roof. He allows an increase of 25% for bracing and combined stresses due to wind and other loading.

An interesting monograph on "Wind Pressure in Engineering Construction," by Capt. W. H. Bixby, may be found reprinted in ENGINEERING NEWS of Mar. 14, 1895.

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Downward Ventilation in a Schoolhouse*

BY CLINTON E. BEERY†

The system of heating and ventilation for the Hall School Building, Rockford, Ill., was designed by and installed under the supervision of the author last summer, and has been in operation since the beginning of the last school year. In view of the revolutionary tendencies in the method, he desires to make a brief explanation, believing it will help to convey a clearer understanding of the theory on which this installation operates. Incidentally, he has applied for a patent on the system.

In the author's experience, based for the most part on practice and observation, he became impressed with the importance of saving, if possible, the great heat losses frequently found in fan-blast heating and ventilation, which seemed to him not only a waste, but actually a handicap to good results. With the knowledge that air of lower temperature and greater density always finds a position at the floor, and that higher temperatures prevail at the ceiling, he reasoned that, if the temperature near the ceiling could be controlled by some means other than the ventilating apparatus, the air customarily at a high temperature at or near the ceiling could be held to a minimum difference in temperature between the floor and the ceiling, and in this way a beneficial influence could be produced on the results obtained from the ventilating apparatus.

With this theory as a basis he first arranged in 1912 a regular school room for experimental work. This was in the northwest corner of the first floor, the coldest room in the building. On the second floor, directly over it, was an exact duplicate of it. Each of these rooms was 26 ft. by 31 ft., with ceilings 13 ft. 6 in. high. Each had 100 sq.ft. of glass exposure facing the west, and 50 sq.ft. of glass exposure facing the north. All windows are protected with wood grooved weather strips. These two rooms were operated the remainder of the heating season, and more or less careful observations of their operation noted.

During the early part of January a comparative test was made of the room temperatures, with 60 sq.ft. of wall radiation in the northwest corners. The air delivery in the rooms was 1544 to 1560 cu.ft. per min., measured at the exits. Twelve temperature readings were taken at 5-min. intervals in each corner of both rooms. Twelve readings of the temperature of the entering air were also taken at 5-min. intervals. The outside temperature at the time of the first reading was 2° below zero F., and at the time of the last reading 3° below. An extremely cold west wind, estimated at 18 to 20 miles per hour, was blowing. The maximum and minimum temperature, Fahrenheit, of the twelve readings taken are given in Table I:

TABLE I—MAXIMUM AND MINIMUM EXPERIMENTAL-ROOM TEMPERATURES DURING COMPARATIVE TESTS

Room	Northwest corner.	Northeast corner.	Southeast corner.	Southwest corner.
Experimental	70-67	71-70	70-68	69-67
Regular	83-80	70-68	69-66	69-64

The temperature of the entering air as per twelve readings, expressed in Degrees F., at 5-min. intervals, are given in Table II:

TABLE II—TEMPERATURE OF ENTERING AIR DURING TEST, EXPERIMENTAL AND REGULAR EQUIPMENT

Room	1	2	3	4	5	6	7	8	9	10	11	12
Experimental	74	70	72	73	70½	73	70	71	73	70	73	69
Regular	68	76	109	76	98	72	80	94	68	97	65	83

A simple device for humidifying was located between the tempering stacks and the fan inlet, and controlled by a humidistat, which was in a part of the building isolated from any influence or conditions in rooms Nos. 3 and 8. The relative humidity readings in the experimental room showed 63%, and in room with regular heating, 54%. With the encouraging results there obtained the Hall School was equipped throughout, during the summer, with the new method and has been in operation since Sept. 1, 1912.

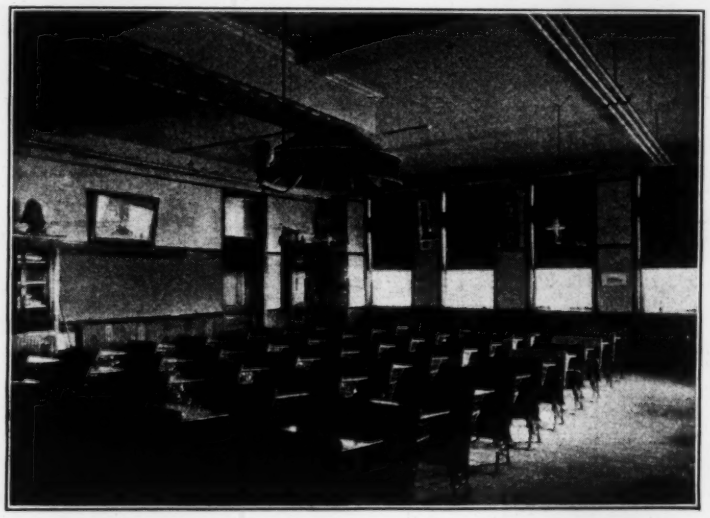

FIG. 1. A ROOM IN THE HALL SCHOOL, AT ROCKFORD, ILL.

The building is of brick with wood-floor construction, two stories in height and full basement. It contains five regular school rooms on each of the two floors, with wardrobes, recitation rooms, principal's office, and corridors. The contents above the basement comprise 124,500 cu.ft. The building has a pitched roof with asbestos slate covering. One room in the basement is used for the mechanical equipment. The powerhouse is isolated and constructed mostly below grade. It communicates with the mechanical equipment room in the basement by a concrete tunnel 4 ft. wide, 6 ft. 6 in. in height, and 17 ft. long.

The mechanical equipment comprises a multivane fan (No. 13) direct connected to a side-crank engine, and operating at 174 r.p.m. All radiation and blast coils are operated on a vacuum system. Temperature regulation with intermediate control is used in each room. All galvanized ducts from the plenum chamber are of regulation design, with the exception of having been run to points where it was possible to take air delivery into the rooms from the front end.

Each of the ten school rooms is equipped as follows: A coil consisting of about three 1¼-in. pipes, extends entirely around the room approximately 5 ft. from the exposed walls and 6 ft. from the inside walls. These pipes are suspended by special hangers 20 in. below the ceiling, as shown in an accompanying illustration. These coils are supplied indivi-du-

*From a paper before the American Society of Heating and Ventilating Engineers. New York City, Jan. 21, 1913.

†Superintendent of Buildings, Board of Education, Rockford, Ill.

ally by a 1¼-in. riser from the main in the basement. The riser is equipped with a modulation valve about 34 in. above the floor, which gives it a slight offset. A single return takes care of two coils from the first and second floors respectively.

A galvanized-iron duct, 14x28-in., extends from the connection with the flues from the basement to a point centrally over the seating section of the room, from which the air is delivered to the room through an especially constructed diffuser, which breaks the velocity and directs the fresh air out in all directions over the breathing zone. This diffuser is located at a height to admit the air for ventilation to the room just below the stratum of the air at the ceiling, which is holding a uniform density by contact with the direct radiation.

The foul-air exits on the first floor are at the floor line in the four corners of the room, and are faced with sheet-metal frames and louvers. The air discharges into vertical galvanized pipes, 12 in. in diameter, which extend upward through the second floor.

The foul-air exits on the second floor are located the same as on the lower floor, and connect with the foul-air, 12-in. round pipes from below, increased to 17 in. in diameter. These vent pipes lead to the attic, where they are gathered in groups, and discharge to the outer atmosphere. The sizes of these vent pipes were simply increased by multiples of the cross-sectional area, the increase of resistance being relied

FIG. 2. STEAM TEST FOR AIR DIFFUSION; HALL SCHOOL, ROCKFORD, ILL.

on in the use of this method to maintain a sufficient static pressure in the rooms. All galvanized vent pipes below the attic are lathed and plastered on the outside. Only the exit frames are visible.

The air for ventilation is directed over the area of the room and is increasing in density at the moment of discharge. The air is forced out of the room at the floor line, producing a general downward velocity of approximately 2 ft. per min. with positive absence of lateral drafts or air currents. This condition is not disturbed until below the top of the exits, and even then there is no noticeable air movement over the floor, due to the comparatively small exits compared with the size of the room. Each vent screen contains 1.1 sq.ft. clear area, which equals 4.4 sq.ft. for each room.

Table III gives the velocity and delivery records of all exits for ten 1-min. readings, taken after the system has been put in operation.

TABLE III—RECORDS OF EXIT AIR VELOCITIES AND DELIVERES, HALL SCHOOL

Room Number	North-west exit.	North-east exit.	South-east exit.	South-west exit.	Total delivery cu. ft., per minute.
1	270	384	326	400	1518
2	390	394	396	350	1683
3	390	400	450	314	1709
4	332	354	460	446	1751
5	364	360	334	332	1529
6	336	346	345	342	1506
7	352	406	334	350	1586
8	434	428	448	366	1843
9	344	328	356	384	1553
10	412	336	370	282	1590

The following is a summary of observations made while this system has been in operation:

A temperature of 85° at the ceiling has been found to be sufficient as a maximum.

The temperature is controlled within a range of 1 deg., F., in all parts of the room throughout the breathing zone.

Air never enters the room above 73° to 74° F.

All rooms show an absolute sense of proportion and freshness.

There is no noticeable effect on the conditions of the rooms caused by the glass exposure, but tests show a slightly higher rapidity in downward movement of the air surface several inches in from the glass.

The air distribution is positive and under normal school-room conditions, the aërial envelope around any individual is moving downward and does not come in contact with that of another but is discharged from the room without rising again to the breathing zone.

There is an entire absence of drafts or currents, and the cold surface of desks and furniture does not contrast against high temperatures of atmosphere surrounding them, as is often complained of in other systems.

During the week of Dec. 15, 1912, tests were conducted by the school authorities. The temperature was uniformly 68°, and the humidity 58%. To demonstrate that no cross currents existed, live steam was introduced into the room through the diffuser in the ventilating system (Fig. 2). The steam distributed equally throughout the room and dropped gradually toward the floor, like a blanket, until it reached the level of the exits through which it escaped. Another test comprised the suspending of a large number of strings about the room with small pieces of paper attached to the end of each. The absence of any swaying of these pieces of paper showed that there were no cross currents generated by the ventilating system.

Some observations have been made of the amount of leakage. Readings of static pressures were taken with a differential draft gage, which, being balanced at zero outside of the building, showed 0.03 in. pressure when connected with the inside of the room. All windows are provided with grooved weather strips, and are more than ordinarily tight, yet all these tests where steam was turned into the room showed a decided leakage outward, particularly between the meeting rails of the sash, which were purposely pried slightly open to allow a chance to observe if leakage was inward or outward.

Economy of operation is evident, but as yet no effort has been made to determine any facts or comparative saving. The studies of this method are incomplete at this time, owing to not having the time or opportunity to continue an uninterrupted study.

[The author reports a supplementary test on Feb. 4, 1913, comparing one room with a room in another building. The one room (Hall School) had 10,296 cu.ft. contents, 873 sq.ft. exposed wall, 159 sq.ft. glass while the other had respectively 11,016 cu.ft. contents, 555 and 168 sq.ft. of wall and glass. The respective air deliveries were 1529 and 2024 cu.ft. per hr. and the air changes 6.5 and 5.5 per hour. The outside temperature rose from 9° F. at 7:20 a.m. to 14° at noon.

At 7:10 in the Hall School the entering air was raised to 72° and to 121° at the Freeman. From 7:35 a.m. to 8:45 the air at the Hall building was kept at 76° and from then to 11 o'clock did not vary 1° from 75°; from then to noon it was held at 70°. The room temperature rose from 40° to 68° (at 8:30) and remained constant until 10:30 when it rose. The rise was checked and the room was again at 68° from 11:10 to noon.

In the Freeman building room, the entering air was held between 120° and 126° until 8:45, when the room reached 76°. By varying the temperature of the entering air between 70° and 125°, the room temperature was held to within 2° above or below 70°. From 10:50 this result was secured by small variations of entering air temperature—first 75-105 and then 74°-85°.—Ed.]

The consensus of opinion with the members of the Board of Education is that the installation at Hall School is a decided success. Teachers are enthusiastic. Pupils show no signs of restlessness toward the close of the school day. The school principal claims a noticeable improvement in the work done by both teachers and pupils.

Heat Indicator for Bearings—A new heat indicator introduced by the General Electric Co. (Limited) consists of a paint for application to bearings or other parts of machinery and electrical apparatus, which normally is of bright vermilion, but on reaching a temperature of 120° F. shows a change of color and at 190° to 210° F. is almost black. When the temperature of the part falls below 120° F. the paint resumes its normal red color. It is claimed that the paint is practically indestructible, that it is unaffected by lubricating oils, that it prevents the formation of rust, and that the warning which it gives enables a machine to be stopped before any damage is done by overheating.—London "Times" (Engineering Supplement), Dec. 26, 1912.

Bulkhead and Pier for the New Port of San Diego, Calif.

San Diego, Calif., is the most southerly of the American and Canadian Pacific ports which are now engaged in a suddenly acquired activity to enlarge their facilities to meet the expected traffic through the Panama Canal. It is located at the extreme southern end of California, within 10 miles of the Mexican boundary line, on one of the most nearly land-locked harbors of the world. In natural facilities and location it is one of the finest ports on the Pacific coast, but its railway isolation is such that the advantages gained by its fine harbor are very apt to be offset by the difficulties of rail transportation to other points of the state. If San Diego were provided with a terminal for some transcontinental railway, or even with some eastern connection to a transcontinental railway, it would have undoubted advantage as a port of call for all ocean traffic to South America or through the Panama Canal, but unfortunately at present its only rail communication with the inland is a line along the coast to Los Angeles, and thence inland. There is in course of construction a railway to connect San Diego to Yuma, Ariz., where it will connect with transcontinental railways, but this road has so far only been built for 14 miles east of San Diego and, according to latest published statistics, it is under construction only for 40 miles. The distance from Yuma to San Diego is about 220 miles.

Nevertheless, the city of San Diego is now engaged in an extended port improvement. In 1910, the State of California voted $1,500,000 in bonds for the development of a harbor, but at the request of the people of San Diego the legislature afterward annulled this grant and deeded all tide land within the city limits to the city of San Diego on condition that the latter expend $1,000,000 in port developments along specified lines and within a specified time. On Nov. 14, 1911, the citizens voted the required $1,000,000 and under this appropriation work was immediately started. The legislative act carries with it certain saving clauses which prevent the city government from ever disposing of any portion of the tide land or the leasing thereof for abnormal periods, and it further protects the municipality by forbidding extended areas being leased to any party or aggregation of parties. Saving clauses are also inserted which prevent the monopoly of the berth or dock space.

A tentative scheme for future improvement has been made, and in the immediate development of a portion of this scheme work has been started on a bulkhead and pier at the north end of the city's waterfront and provision made for extensive dredging in the harbor proper.

The Bay of San Diego comprises an area of 22 sq.mi. It is completely land-locked and has a depth of water over the bar of 31 ft. at low water. The main channel inside the bay will average from 1500 to 2000 ft. in width and from 35 to 60 ft. in depth at low water. The tentative plans for the ultimate improvement of the harbor contemplate piers 1000 ft. in length and 130 ft. in width, with slips of 250 ft. They are designed to extend out diagonally from the reclaimed shore line. With this arrangement the ultimate berth room will aggregate approximately 30 miles. In addition to this there is to be reclaimed between 50 and 60 acres of tide land, which are to be made by dredging the necessary channels and depositing the material behind bulkheads. This dredging is now going on with two hydraulic dredges owned by the city. The floor of the bay is of such character as to present a firm foundation for harbor improvement, but at the same time it yields readily to dredging at a minimum cost. No fresh-water streams flow into the bay, so consequently when once dredged the work is practically completed, thus eliminating one of the chief sources of expense in harbor upkeep.

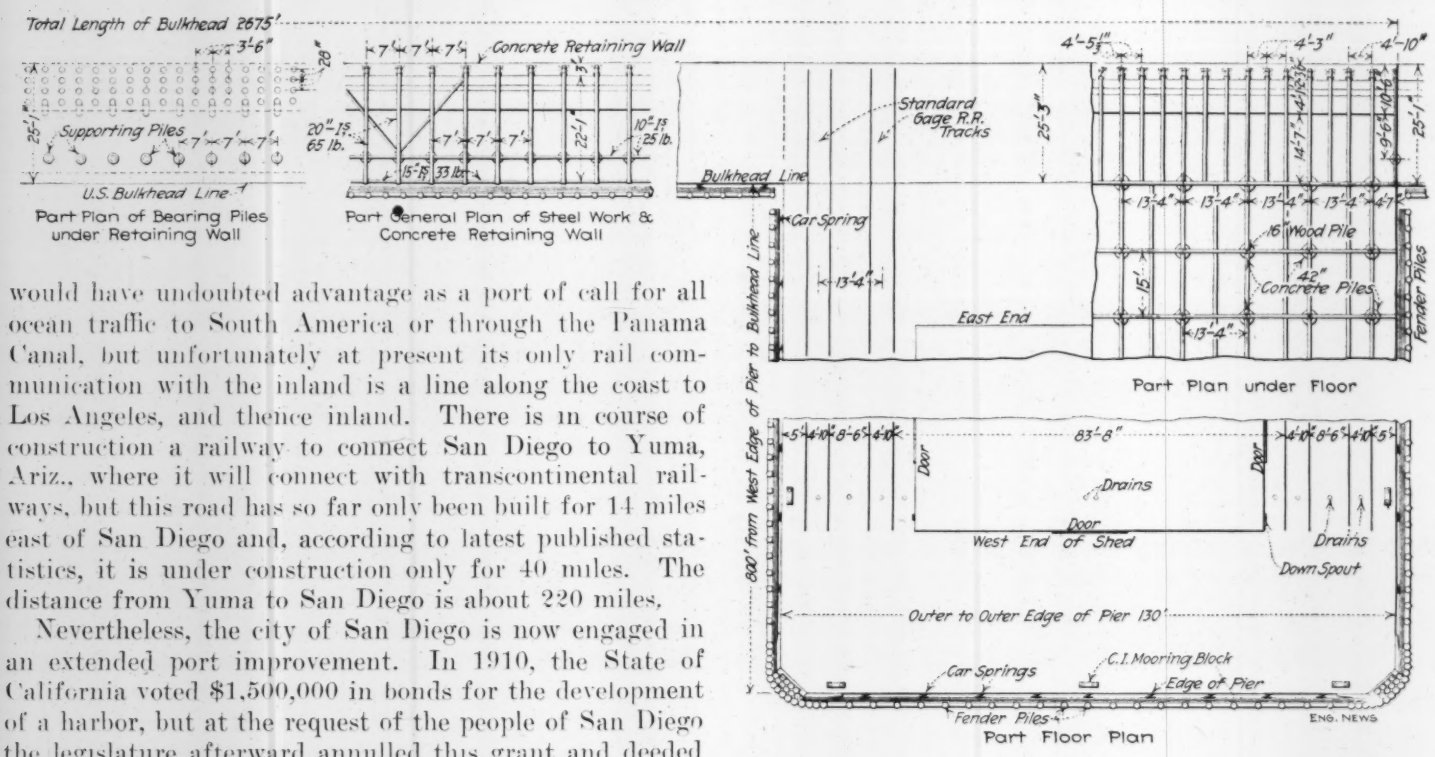

FIG. 1. PLAN OF BULKHEAD AND PIER, SAN DIEGO, CALIF.

The data regarding the new port may be summarized as follows:

Area of bay, 22 sq.mi.
Area of tide land, belonging to the city or port, 1450 acres.
Length of piers proposed, 1000 ft.
Width of piers proposed, 130 ft.
Distance between piers, 250 ft.
Length of bulkhead line in front of city, 11 mi.
Approximate ultimate berth room in city control, 30 mi.
Depth of water over the bar at low water, 31 ft.
Depth of channel inside of bay, 35 to 60 ft.
Average width of channel, 1500 to 2000 ft.
Average rise and fall of tide, 5 ft.

The improvements under construction at present comprise a length of bulkhead some distance out from the present shore line, with a 130-ft. pier at one end of it (Fig. 1), besides the reclamation of tidal land, which is going on at the same time. The bulkhead, as will be noted from Fig. 2, consists of a gravity concrete retaining-wall, founded on wooden piles, against which the reclaimed tarth is pumped, and arrying in front of it a concrete-slab floor, resting at its inner edge on the retaining-wall and at its outer edge on concrete piles driven

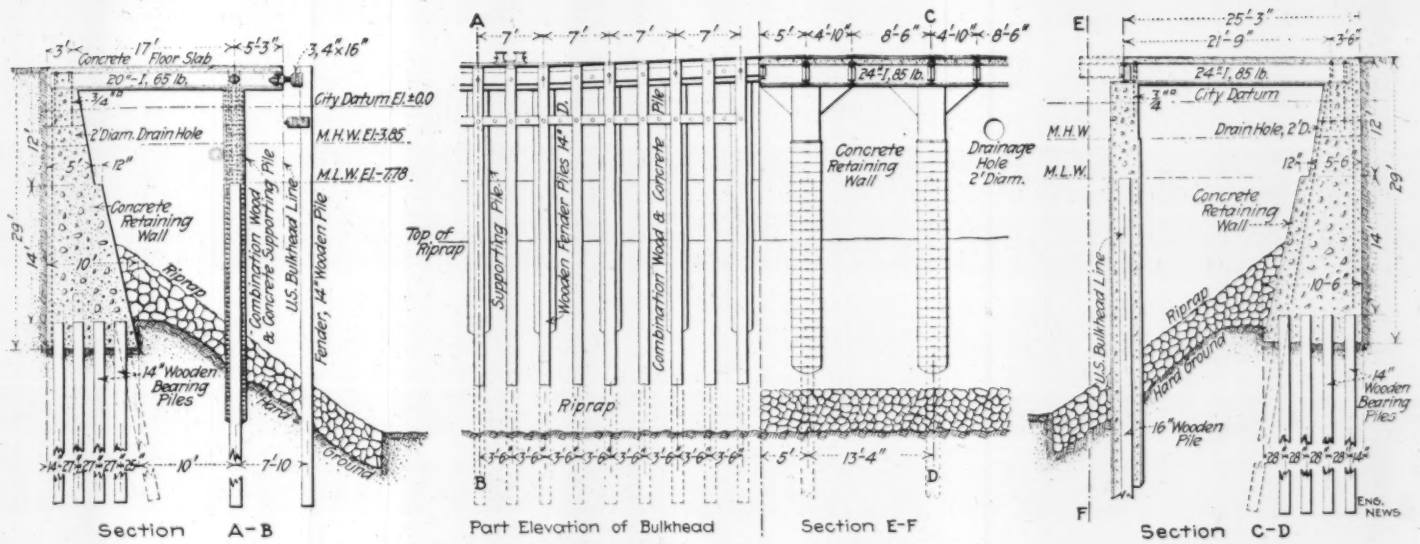

FIG. 2. DETAILS OF BULKHEAD CONSTRUCTION
[Section A-B at bulkhead proper; Section C-D at pier]

into the harbor. The main section of this extends for seven blocks, a distance of 2675 ft., while the pier extends out of one end of it a width of 130 ft.

Fig. 2 (Section A-B) shows a section through the bulkhead. The outside bearing piles, as will be noted in the figure, consist of wooden piles, 14 in. in diameter, driven into the harbor bottom and surrounded above water by concrete piles which carry on their upper ends the transverse I-beams, which are incased in concrete to form the floor-beams. The piles are made by first driving the timber pile, then sinking above it a hollow concrete cylinder, cast on shore, to a depth 4 or 5 ft. below the bottom of the harbor and filling the cylinder around the wooden pile with concrete. They are spaced 7 ft. c. to c. At the extreme end of the floor-beams there are spaced every 3 ft. timber fenders with car-spring buffers, spaced every 14 ft.

At Section C-D, Fig. 2, is shown the section through the portion of the bulkhead at the pier. The design is similar here to the bulkhead proper, except that a larger concrete pile carries the outer end of the floor-beam and the spacing of these piles is somewhat different. The pier is 130 ft. wide and 800 ft. long. The concrete piles are bracketed at the top to form column supports to the I-beams, which are incased in concrete and which carry in their turn a concrete slab with asphalt paving for a floor. Running along either side of the pier are two railway tracks of standard gage, which extend out from the shore and which will connect eventually with a municipal port railroad.

The supporting piles under the pier are being built according to a specification that reads as folows:

After dredging the bottom of the bay to the approximate depth required for the concrete footings to the piles, a steel cylinder caisson 7 ft. in diameter of sufficient strength to resist the external pressure of the water, and of necessary length to reach to the desired depth, shall be brought into position concentric with the center point of the pile to be constructed, it shall then be driven down into the mud and earth constituting the floor of the bay until the outside water is entirely cased off. The mud and water on the inside of the caisson shall then be removed and the earthern bottom excavated to a satisfactory depth, and a safe bearing ground of not less than 3 tons per sq.ft. is obtained for the concrete footing of the pile. After which, the wooden pile constituting the central core of the pile, shall be brought accurately into position, perfectly plumb, concentric with the exact point of alignment and driven down to a 30-ton safe bearing load, which shall be determined by the drop of a 2000-lb. hammer for a distance of 19 ft., with a penetration of ¼ in. for each of the last five blows of the hammer, the head of the pile being sawed off square, presenting a hard, firm surface to the hammer for each blow.

The top of the wooden pile shall be sawed off at right angles to its length, at any point between mean low-water mark and 18 ft. below the city datum plane of levels.

The wooden stave cylinder, reinforcing metal and the cement concrete shall then be placed into position all as shown on the plans hereto attached and in the manner as specified herein.

The inside of the steel caisson shall be free from water at all times during the construction, and under no condition shall any concrete be deposited under or into water.

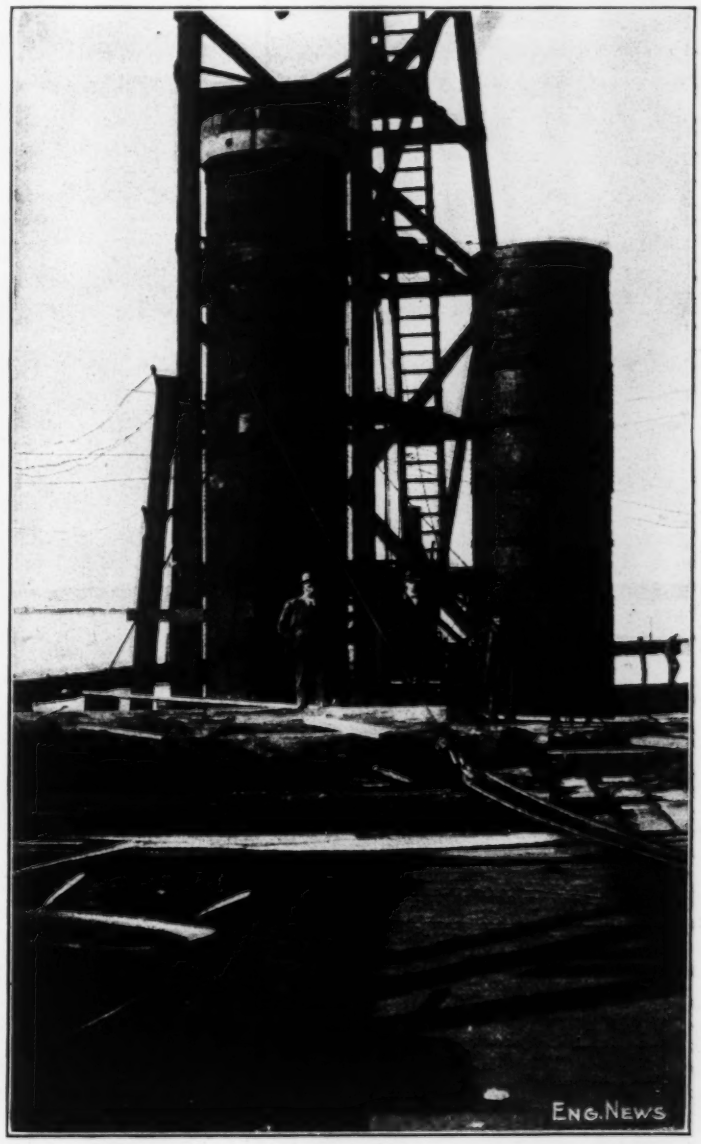

FIG. 3. VIEW OF STEEL CAISSONS USED IN PILE CONSTRUCTION, SAN DIEGO HARBOR

The Engineer shall determine the depth of concrete footings for each pile, and he shall be the sole judge of the fitness of the bearing ground for the concrete footings to each pile constructed. No concrete shall be deposited upon said bearing ground until permission is given the contractor to do so by the Engineer.

In the event that satisfactory bearing ground cannot be had at a reasonable depth, then resort may be had to driving of wooden bearing piles in the manner as shown upon sheet No. 2, of the plans hereto attached. In no case shall resort be had to this form of construction without the written consent of the Engineer.

The steel caisson shall remain in place for at least 48 hours after the last concrete is deposited, and then removed with such care as to prevent any disturbance whatever of the completed work.

Immediately after the removal of the steel caisson, the completed pile shall be rigidly braced in all directions to absolutely prevent any movement or displacement.

Fig. 3 is a view of the two steel caissons used in making the pier piles. These caissons are made of boiler plate, ¾ in. thick in the bottom rings and ¼ in. thick in the top rings, with a heavy reinforced cutting ring on the bottom. A heavy wooden cap is used on top of the caisson to cushion the blows of the hammer, which in this case weighs 4000 lb. The derrick which manipulates these caissons is capable of lifting 100 tons, which capacity is nearly reached in pulling the caissons.

On the pier proper is to be built a steel-frame warehouse, 72 ft. clear in width and 765 ft. long, which will be provided with roller doors, skylights and ventilators all in accordance with the best modern practice. For facilitating the rapid handling of cargo a number of loading platforms and auto trucks will be provided. Alongside the pier 35 ft. of water will be maintained, and alongside the bulkhead 20 ft.

The harbor work is under the direction of the city of San Diego and under the special direction of Edwin M. Capps, Supervising Engineer, to whom we are indebted for the accompanying drawings and technical description.

The contract for the bulkhead was let to Shields & Son, San Diego, for $330,000; that for the pier to Messmer & Rice, Los Angeles, for $350,000. The city is doing its own dredging, with two suction dredges, one with a 12-in. and one with an 18-in. pipe. It is expected that the work will be completed in February, 1914.

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Electric Power Distribution for the Panama Canal operation and lighting will require 246 miles of lead-covered cable, which is about 40% of the total amount placed by the largest electric power company in the United States during the 20 years preceding 1908. These cables will be carried through the lock walls in vitrified clay ducts. On account of the large amount of cable to be placed in the ducts a special device using an electrically operated winch was resorted to.

Before the operation is begun the ducts are carefully cleaned. Then a small steel lead wire is pulled through, and by this means a manila cable is drawn through the duct. The electric cable is attached to the rope, and the winch is set in motion. By this method it is possible to pull 900-ft. lengths of No. 0000 B. & S. gage lead-covered cable at one time, whereas the average length by other methods is about 300 ft. The outside diameter of this cable is a trifle more than 2 in. In such a length the cable passes through two intermediate manholes, and is greased at three points to aid in reducing friction. The advantage of pulling the long sections at one operation is that the making of two joints is saved, and this is a considerable economy. The winch used for the purpose is mounted upon trucks operated over the return tracks of the canal towing system. The cable is placed directly below the floor of the operating tunnel, and therefore the pull by the winch is direct.

In addition to the amount of cable mentioned above, the lighting system will require about 112 miles of wire of miscellaneous sizes from Nos. 12 to 00 B. & S. gage.

Oil Pipe Lines in California

By B. K. Stroud*

The first oil pipe line of any length in California was built by the Standard Oil Co. in 1901 from the Kern River fields in the San Joaquin Valley to Point Richmond, on San Francisco Bay, a distance of about 300 miles. The line was 8 in. in diameter and the pumping stations were placed approximately 24 miles apart, as was the company's practice in the Eastern oil fields. By reason of the heavy gravity of the oil of the Kern River fields (12 to 16° Baumé) it was found that the pumps could not move it, although steam heating to high temperatures was resorted to. As a result, twelve intermediate stations were added, and the oil was then moved through to Point Richmond satisfactorily.

The Associated Pipe Line Co., in 1907, built a pipe line from the Kern River fields to Porta Costa, a distance of about 280 miles, Porta Costa being at tidewater, about 30 miles north of San Francisco. This also was an 8-in. line, but the pipe, instead of being smooth, was corrugated or "rifled," the corrugations making one complete revolution in every 10 ft. This was a new departure from anything previously tried in pipe-line practice, and its working was watched with great interest. In theory, enough water was to be injected into the line at each station to encase the oil in a water envelope, thus giving the oil a water bearing and reducing the friction. This pipe is known as the "rifled-pipe" by reason of the rotary motion it imparts to the oil. It was found in practice that 10% of water was about the necessary proportion to move the oil readily, and by reason of the reduced friction the Associated Pipe Line Co. found it practicable to put the pumping stations approximately 26 miles apart. The oil was heated slightly in order to bring it freely to the pump from the tanks, high temperatures not having been found necessary. This line has been in use for the past five years and is a pronounced success.†

There are now several oil pipe lines in California, but their equipment is much the same in each case. In general, each pumping station is composed of from three to five water-tube or Scotch marine boilers of 200 to 250 hp. each, fired with oil, and two horizontal duplex compound steam pumps connected in manifold. The oil end of the Associated Pipe Line Co.'s pumping engine is 9½x36 in. and moves a barrel of oil per revolution. The engines are run from 12 r.p.m., on heavy gravity oil, to 22 r.p.m. on higher gravity oil, and will move from 15,000 to 25,000 barrels per 24 hr. An 8-in. pipe line equipped with these pumps has moved over 30,000 bbl. of oil per 24 hr., or over 1,000,000 bbl. per month. The average, however, is about 22,000 per 24 hr. Each station has from two to five tanks of 55,000-bbl. capacity each, and if the topography of the country permits, these are set above the level of the pumps, in order that the oil may flow by gravity to the latter. The suction lines are from 20 to 28 in. in diameter. Four men are in charge of each station, working in pairs for alternate shifts of 12 hr. each. Telephone and telegraph lines parallel all pipe lines, and the companies have installed shops at important points, so that breaks in the lines or the machinery are taken

*Universal Oil Co., Wasco, Calif.

†The use of rifled pipe on an earlier oil pipe line of the Southern Pacific Ry. was described in an article by J. D. Isaacs, Consulting Engineer of the Harriman Lines, in "Engineering News" of June 7, 1906.

care of with dispatch. The pumping stations and pipe lines are built in a substantial manner, and their efficiency is correspondingly high.

Nearly all the oil pipe lines in California are of steel pipe 8 in. diameter, weighing 28 lb. per ft. and tested to 1500 lb. pressure per sq.in. The working pressure is about 750 lb. Openhearth steel pipe is preferred, but bessemer steel is used extensively. The pipe is all made at Eastern mills, and the sections are 20 ft. long. Ordinary screw couplings are used on nearly all the lines, although in some cases there are flanged unions joining the blank ends of the joints. There is practically no leakage at the joints, the lines being generally tested under water pressure before oil is pumped through them. No air chambers are used, but relief valves are often placed at the summits.

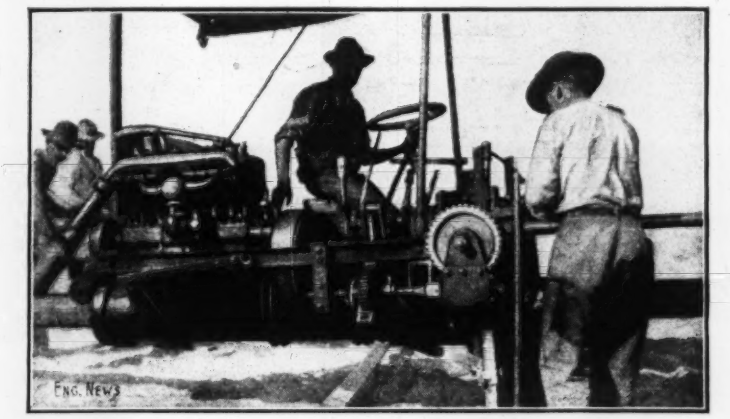

FIG. 1. MACHINE FOR MAKING SCREW JOINTS ON OIL PIPE LINE IN CALIFORNIA

The pipe lines, as a rule, have their sources in the warm interior valleys of the state and before reaching the coast have to pass over high mountain ranges, and are therefore subjected to more changes of heat and cold than is usually supposed. Each company therefore has its own problems to solve, so California has been the pioneer in many branches of the pipe-line transportation practice. The low-temperature conditions at the high summits are met by burying the pipes much deeper than in the valleys, the depth being 3 to 4 ft. below the surface, instead of 20 to 24 in. As to the profiles, the Standard and Associated pipe lines through the San Joaquin Valley are practically level; the Coalinga-Monterey line has an elevation of about 300 ft. at its initial pumping station in the oil field, and 20 miles beyond this it reaches an elevation of 2300 ft. The General pipe line from Maricopa to Los Angeles has a maximum elevation of about 4000 ft. All the lines terminate a few feet above sea level. In curvature, it is aimed to have a radius of not less than 150 ft. for changes of direction.

In laying its lines, the Associated Pipe Line Co. cuts a trench 18 in. wide, and the pipe is thrown to opposite sides of the trench every 100 ft., thus providing for expansion in the line. The Standard Oil Co. does not provide for expansion. The lines are buried at least 20 in. deep, and in crossing a marsh or stream the lines are placed on trestles. As a protection to the lines, coatings of especially prepared asphalt are applied after the pipe has been scraped to remove all mill scale. The pipe is then wrapped with an asbestos or fiber paper, after which another heavy coat of paint is applied. This work is very necessary to protect the line from moisture and alkali in the soil. Otherwise the life of the pipe would be short. Pipe-laying, trenching and backfilling machines have been invented which do the work of several men and insure more uniform results. The trenching machines are ordinary power-driven bucket machines, or revolving wheels carrying buckets. Backfilling machines are road graders or V-scrapers drawn by horses.

A pipe-laying or pipe-jointing machine has been invented by Mahoney Brothers which will lay 7000 ft. of pipe per day with a complete crew of 20 men, as against 50 or 60 men with tongs. Fig. 1 is a view of the machine and Fig. 2 shows it on a pipe line. It is run on the pipe, which it uses as a track. The motive power is supplied by a marine or automobile gasoline engine of the four-cylinder vertical type, water cooled, the machine carrying an ordinary auto radiator and fan. The illustrations show the machine and its position on the pipe. The line runs through a 10-in. pipe or sleeve under the machine and when the latter is ready to travel, the legs which support it on the ground are automatically drawn up until the machine rests on the pipe. A clutch is then thrown in, which causes the small rollers inside the 10-in. sleeve to revolve, thus moving the whole forward. It is prevented from turning over by a long lever on the side, which is handled by the men. The pipe line is supported at the end by blocking and as soon as the machine reaches the end of the joint, the legs are again thrust to the ground and the weight of the machine taken off the line. A joint of pipe is swung in by the boom, automatically

FIG. 2. LAYING AN OIL PIPE LINE IN CALIFORNIA, WITH A MACHINE FOR SCREWING UP THE JOINTS

placed into position and caught with the grip, which rapidly screws it up. This grip is operated by an ordinary automobile clutch. The machine is further supported when on the ground by cross pieces of wood, which prevent it from turning over into the trench.

The Standard Oil Co. has large tank farms both at Bakersfield and Point Richmond. In the latter city it has its refinery, and all the oil taken from the San Joaquin Valley by the company goes to that point. The Associated Oil Co. markets the oil for fuel, and maintains a fleet of tank steamers and oil cars for that purpose. Its equipment at Porta Costa is such that it can load a 55,000-bbl. tank steamer in less than 2 hr.

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Mortality Statistics of the Pennsylvania Coal Mines, during 1912, are contained in the annual report of the Department of Mines. In the bituminous branch, 160,973,500 tons were mined, 182,700 men and boys employed, and the death list summed up to 437. In the anthracite fields, the production was 84,258,100 tons, and of the 175,900 employees, 593 were killed.

A New Module or Constant-discharge Device for Irrigation Works

An irrigation module without moving parts, which effects an approximately constant discharge of water under varying heads by means of a series of obstructing plates, let part way down into a trough, which is rectangular in section and circular in plan, has been devised by A. Shirra Gibb, executive engineer, Irrigation Department of Punjab (Lahore, India). The baffle-plates serve to destroy the head in excess of what is needed to give the desired volume. We are indebted to Mr. Gibb for the following description of the device:

In its simplest form the apparatus, in which the regulation of the supply is effected, consists of a semi-circular

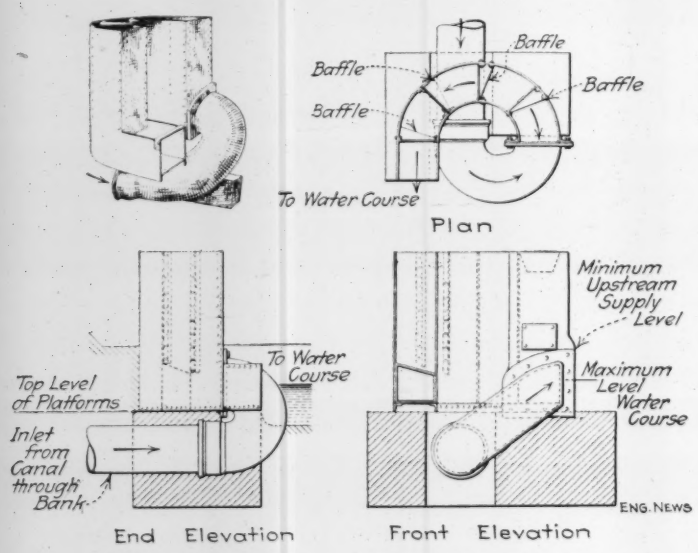

FIG. 1. THE GIBB IRRIGATION MODULE

[in plan], flat-bottomed, steel trough of considerable depth, round the bottom of which the water flows (see accompanying sketch and details, Fig. 1). The water enters the trough at one end through a 180° bent cast-iron pipe, the upstream end of which communicates with the canal through the bank by means of the requisite length of straight pipe. The exit is at the other end of the trough.

The 180° bend and the semicircular trough together form a complete loop round which the water flows and in which a condition of free vortex flow becomes established. In this condition the water at the outer circumference of the stream is kept up at a comparatively high level by its centrifugal force and the surface curves down convexly toward the inner circumference. The height at which the water flows round against the outer circumference of the trough depends on the velocity, being higher the greater the velocity.

A series of baffles are fitted at intervals across the upper portion of the trough, their lower edges being cut and bent in such a way as to allow just the required discharge of water to flow below them uninterrupted. These diaphragms come into play whenever the head of water in the canal is such as to cause the water at the outer circumference of the trough to rise above their lower edges. When this happens a portion of the stream at its outer circumference is interrupted by the diaphragm, and its centrifugal force being thus destroyed, the water falls across the stream to its inner circumference, where the surface is low. This fall of the water and the circulating cross or radial flow which it produces uses up the energy that the water had by virtue of the increased head in the canal, and leaves only sufficient to discharge such supply as can pass undisturbed under the remaining diaphragms.

As the head increases and more energy has to be eliminated the diaphragms come into action in turn, beginning from the upstream end of the trough, but no action can take place downstream of the point at which the energy in the water is reduced to the required amount. Thus, the correct supply is discharged constantly in spite of variations of head in the canal.

The minimum head required to give the correct supply is very small, being very little more than is carried by the water in the form of velocity head. This is an important point because the head available is often only a few inches.

There can be no question of this module being tampered with by those interested in the water-supply, because short of complete demolition there is no means by which it can be made to give more than its correct supply; and silt or other matter in the water obviously cannot interfere with its action.

The module is in actual use in India, where about 100 have been installed on Punjab Canals—mostly of an earlier and more complicated design, but employing the same principle.

The irrigation authorities in Sind and in Bengal have installed some of the latest type on their canals. The agricultural departments of Punjab and Bombay each have modules of the latest type installed at their experimental farms for regulating and measuring the quantity of water given to experimental plots. These installations have given entire satisfaction.

As supplementing the description by Mr. Gibbs, we

FIG. 2. CURVE SHOWING EVENNESS OF DISCHARGE FLOW THROUGH IRRIGATION MODULE

reproduce from London *Engineering*, of Jan. 17, a curve (Fig. 2) showing, in the language of our contemporary, "how very effectively the module works throughout its designed range of operation, which in this case is from 9 to 18 in." It may be added that *Engineering* of the date named contains a number of illustrations of the device which were also forwarded to us, but are not reproduced here as our Fig. 1 clearly shows the working principle of the module.

The Gibb module is made by Glenfield & Kennedy, of Kilmarnock, Scotland, under a license from Mr. Gibb as patentee.

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The Automobile Testing Laboratory, maintained in New York City by the Automobile Club of America, and which it was recently reported was to be abolished, will be continued by a recent decision of the Board of Governors of the Club.

Antityphoid Vaccination in the Reclamation Service

By Dr. Hugh A. Brown*

Although sporadic cases of typhoid fever have been reported at long intervals from a few of the larger construction camps of the United States Reclamation Service, these camps have never experienced an epidemic of the disease. This is probably largely due to the fact that from the outset every precaution has been taken to maintain the highest degree of sanitary excellence possible. On the larger works, where often hundreds of men are concentrated in the camps, physicians are employed by the Service, either under contract or holding civil-service appointments. The camps are carefully policed and every attention given to the proper disposal of refuse, purity of the water-supply, the extermination of the so called "typhoid fly" by means of trapping and the destruction of its breeding places, and other incidental sanitary measures tending to maintain the health of the camps at the highest point. Not the least of the reasons for this action on the part of the Service has, of course, been the knowledge that efficiency and health go hand in hand.

Consideration of the remarkable results obtained in the Army, as indicated by the various reports of Major F. F. Russell and others, naturally led to the belief that, in its efforts to maintain high efficiency through proper sanitary measures, the Service should not overlook the prophylactic value of inoculation with antityphoid vaccine. Negotiations were acordingly entered into with the War Department and arrangements made in July, 1912, whereby Major Russell, of the Army Medical Corps, in charge of the bacteriological laboratory of the Army Medical School, was directed to furnish the prophylactic when and in the amounts requested by the Reclamation Service, "payment to be made at the rate of 12½c. for each complete treatment, by transfer of funds at stated intervals."

Compulsory vaccination of the employees of the Service was, of course, impossible, but it was believed that a large proportion would volunteer for treatment if the dangers of infection and the advantages of prophylaxis were fully presented to them. A beginning along this line was made by publishing in the *Reclamation Record* (August, 1912), the official organ of the Reclamation Service, an article contrasting the results obtained in the Army subsequent to compulsory vaccination with conditions as they existed prior to the treatment, briefly describing the method of inoculation and the reactions that might be expected, and urging all field employees to volunteer for treatment.

About the same time there were sent to the supervising engineers, project engineers and project managers copies of Circular No. 7 of the Surgeon General's Office, which describes the method of inoculation, contraindications, and the care of the prophylactic during the course of treatment, together with copies of an article by Major Russell on "Results of Antityphoid Vaccination in the Army in 1911, and Its Suitability for Use in Civil Communities." In addition, the projects received several copies of a circular to be posted in conspicuous places around the camps. This circular, written in more or less popular style, called attention to the danger of contracting typhoid fever, the possible economic loss to the individual and the Service, the comparative harmlessness of the inoculation method of prevention, and the ordinarily slight reaction resulting from inoculation, closing with the folowing injunction:

Typhoid fever can be prevented.
You can aid by being vaccinated.
Prevention beats the physician and undertaker.
Healthy persons may have typhoid tomorrow.
Only those vaccinated or who have had typhoid are immune.
Immunity lasts three years.
Don't hesitate. Volunteer today.

That the employees took a lively interest in the matter was shown by the number of volunteers. During the fall and early winter requests were received for vaccine sufficient to inoculate approximately 500 persons, while up to Feb. 25, 1913, enough of the prophylactic to inoculate 625 persons has been sent to 19 projects and field offices, at a cost to the Service of $78.13. Each treatment consisted of three inoculations at ten-day intervals, the first of ½ c.c. (7½ m.), containing approximately 500,000,000 bacteria, and the second and third of 1 c.c. (15 m.), containing one billion each.

The reports received by the Service regarding the general reactions following inoculation show that in over 92% of the cases such reactions were either absent entirely or mild in character (i.e., presenting a temperature above normal and below 100°; or normal temperature with headache and malaise) following the first two doses, while these results were obtained in all cases following the third inoculation, no moderate or severe reactions being recorded. The reactions were found to be far less severe than those generally accompanying vaccination for smallpox, and in only three or four instances were employees incapacitated for work, and then only for a few hours.

As above stated there have been no epidemics of typhoid fever in the construction camps of the Service. An epidemic has, however, occurred recently at Malta, Mont., a small town with a population of about 450, located on the Milk River project. About twenty cases of the disease developed in a hotel in which the drinking water was furnished from a shallow well. During the period of the epidemic four employees of the Reclamation Service were living at the hotel, two of whom had received the antityphoid treatment prior to the outbreak, while a third had recently had typhoid and therefore did not take the treatment. The fourth man had declined to be inoculated and was the only one of these four to contract the disease. The value of this as an object lesson need not be commented upon.

The cost of typhoid fever per patient, irrespective of lives lost, was estimated in the 1907 epidemic in Pittsburgh at $128, while Dr. Kober estimates the annual loss from this disease in the United States at $350,000,000. It is, of course, impossible to state how many cases of typhoid, if any, among the field employees of the Reclamation Service have been prevented by the use of this latest of prophylactic measures, but, on the basis of the above figures, the prevention of only one case would more than justify the small expenditure made. In this connection it is believed that similar preventive measures might, with propriety, be taken by other employers of labor concentrated in construction camps or otherwise exposed to infection with the typhoid bacillus.*

*U. S. Reclamation Service, Washington, D. C.

*This has been done in a few instances.—Ed.

Action of Acids, Oils and Fats on Concrete

The action of acids, oils and fats upon concrete was the subject of a paper by W. L. Gadd, delivered Dec. 12, 1912, before the Concrete Institute at London, England. In general, Mr. Gadd's conclusions, made as the result of some rather limited study, are the same as have been held for some years in this country, namely, that vegetable and animal oils are destructive of concrete, but that mineral oils have apparently no effect upon concrete which has reached a certain degree of set. His paper, however, was misleading in one respect, in that he seemed to assume that the recent advocacy in this country of oil-mixed concrete as a waterproof material included animal and vegetable oils as well as mineral oils. We quote below a portion of Mr. Gadd's paper:

Neither cement nor concrete will withstand the action of hydrochloric, nitric and sulphuric acids. They decompose and dissolve the constituents of cement, even in dilute solution. Even a weak acid, like carbonic acid, has a distinct action upon cement, which, suspended in water, can be practically entirely carbonated by passing a current of carbon dioxide into it. The action of organic acids, such as lactic and butyric acids, tannic acid, tartaric and citric acids, and acetic acid or stale beer, is not so marked; but it is very probable that the whole of the series of higher fatty acids will be detrimental to concrete. The tendency of organic acids to combine with carbonate of lime is much less than with hydrate of lime, and it follows that an acid which would be dangerous in contact with green concrete might be perfectly harmless in contact with old or indurated concrete. Thus, stale beer has a distinctly detrimental action upon new work, but once the concrete has indurated by exposure to air for some time, the acid of sour beer has little action upon it. Fresh beer has, itself, a weakening action on green concrete; but the deterioration in this case is due to the sugar and other organic constituents of the beer, and not to the action of beer acids.

The author submitted some test pieces of neat and of 1:3 mortar briquettes, first to the action of pure water and second to the action of beer. The test pieces were gauged with water in the usual way, and after 24 hr. in moist air were immersed in water and beer, respectively, until due for breaking. It was found that the briquettes kept in water were about 10 to 15% stronger than those kept in beer. The author further says:

Lactic acid is produced by the fermentation of milk, and is a possible acid to come in contact with concrete structures in farm buildings. The action of this acid is confined to combination with calcium hydrate, forming calcium lactate. This salt is soluble in water, and in wet situations would be readily leached out of concrete in which it was formed, so that the deleterious effect of lactic acid would consist in the gradual removal of the lime hydrate, which plays an important part in the induration of concrete. For practical purposes, it is probable that this action would be very small.

Some tests were made to show the effect of prolonged immersion in a solution of lactic acid, prepared by fermenting milk and removing the curd. Test pieces were placed in water and in whey, but it was found that the results of the two sets of briquettes were so close that no destructive action of the lactic acid could be claimed. The conclusions of the author in regard to the whole matter are given below. It might be said that his tests on the waterproofing of different types of concrete do not appear to us to be very reliable.

CONCLUSIONS

1. The addition of oil or fat, of any kind, to concrete results in a weakening of the strength.
2. Animal and vegetable oils have a direct action on green concrete, and in time will bring about its destruction.
3. Indurated concrete is less liable to be attacked by oils and fats.
4. Oil-mixed concrete is not rendered more waterproof. The least permeable concrete is, in the author's opinion, a dense mortar in which the aggregate is properly graded to fill the voids.

Water Ram in Water-Works Distribution Systems

Two papers on water ram were read at the meeting of the New England Water-Works Association on Jan. 9, 1913. An abstract of each follows:

Lawsuit over an Hydraulic Elevator at Northeast Harbor, Me., and Tests of Effect of Locomotive Standpipe Operation at Ellsworth, Maine

Charles W. Sherman, principal assistant engineer of Metcalf & Eddy, Boston, Mass., related an experience with an hydraulic elevator supplied by the Northeast Harbor Water Co. (Me.), which led to some tests being made on a locomotive standpipe connection, at Ellsworth, Me.

The Northeast Harbor Water Co. supplied an hydraulic elevator in a hotel through a 4-in. pipe 300 to 400 ft. long, connected with an 8-in. supply main at a point two or three miles below the lake intake. The static pressure at the hotel was 30 lb. and a relief valve, set at 45 lb., was installed near the elevator.

The company pressed the hotel to install a tank for the supply of the elevator. After litigation, the State Supreme Court held that this request was reasonable.

Mr. Sherman was called in to testify for the hotel. Local data as to the increase of pressure caused by the operation of the elevator not being available, experiments were made on the water-works of Ellsworth, Me., where the court was being held. For this purpose, a 4-in. pipe, some 400 ft. long, supplied a locomotive standpipe under a normal pressure of 68 lb., was selected. This pipe connected with an 8-in. main which came from a distant reservoir.

Quoting now from Mr. Sherman's paper:

The pressure gage was attached to a house service pipe about 150 ft. from the locomotive standpipe, and the standpipe valve was opened wide, as rapidly as possible, left open until a condition of steady flow was obtained, and then closed as rapidly as possible. The maximum velocity in the 4-in. pipe is estimated to have been not less than 10 ft. per sec. The time of opening the 4-in. valve was 30 sec., and the time of closing was 20 sec. The pressure dropped almost immediately upon starting the valve from 68 to 28 lb., or to 41% of the normal; and at the instant of closing the pressure gage registered 134 lb., or 202% of the normal.

This maximum pressure is not great enough to be dangerous to any well-constructed pipe system, although the sudden fluctuations would doubtless be annoying at times.

The officers of the water company presented gage readings showing what the actual fluctuations had been in various parts of town. The significant figures, as taken down during the testimony, are as follows:

PRESSURES OBSERVED AT VARIOUS PLACES DURING OPERATION OF HYDRAULIC ELEVATOR

	Pounds per sq.in.		Percent. of normal	
Normal	Highest	Lowest	Highest	Lowest
56	75	40	135	71
58	60	35	104	60
55	62	32	112	58
32	40	10	126	31
32	50	10	156	31
60	80	40	133	67
58	85	35	147	60
55	75	35	136	63
54	70	25	128	46
51	70	28	137	55
30	50	10	167	33
30	50	8	167	27
28	60	10	213	35

The foregoing figures show that in general the operation of the elevator caused a drop in pressure ranging from 40% to between 60% and 70% when the valve was opened, and an

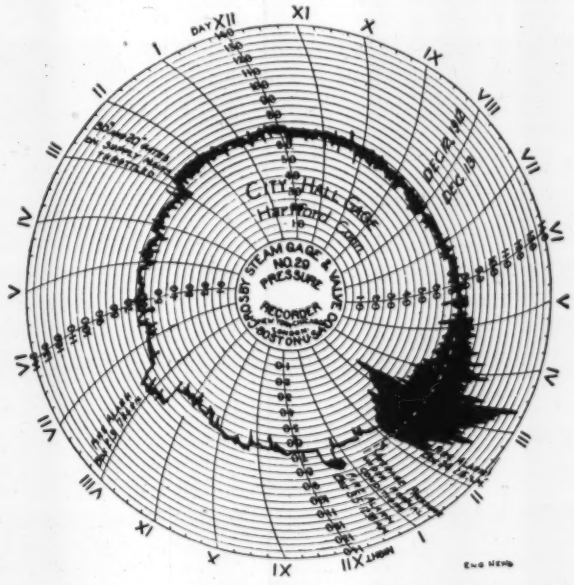
increase in pressure, or water ram, amounting to from 30 to 50% of the normal pressure under ordinary circumstances, and sometimes runing up to about 100% increase in pressure.

These results confirm in a general way the conclusions reached by the writer from the experiment described above—that the pressure might drop about 60% below normal when the valve was opened, and rise to a maximum of about 100% above normal at the moment of closing the valve. These fluctuations are sufficient to cause annoyance, but, where the normal pressures are as low as in the cases cited, should not be dangerous to the pipes.

None of these results can be applied to conditions differing materially from those quoted above, but they may serve to give some indication of the extent of the water hammer that may be experienced in a small water-works system from the rapid closing of valves or fire hydrants.

Experiments with Locomotive Standpipe and with Fire Engines at Hartford, Conn.

Supplementing Mr. Sherman's paper, Caleb Mills Saville, chief engineer of the water-works of Hartford, Conn., recounted some observations which he had made on the works under his charge. These observations were prompted by several breaks in the water mains, which had been attributed to the operation of the locomotive



PRESSURE RECORDING-GAGE CHART, HARTFORD WATER-WORKS SYSTEM, SHOWING VIBRATIONS CAUSED BY FIRE STEAMERS

standpipe at the main station of the New York, New Haven & Hartford R.R.

A recording pressure gage on the 8-in. lateral supplying the standpipe showed extreme vibration of 120 lb. per sq.in. Another gage, at the City Hall, about a half mile from the station, showed "that the water ram impulse is transmitted to considerable distance through a distribution system with a decidedly appreciable force."

Average conditions attendant on locomotive filling through the 8-in. lateral, connecting with a 12-in. and 16-in. main show a velocity in the lateral of 9.5 ft. per sec., and a period of flow of 2 min. 50 sec. The quantity usually drawn is 4230 gal. per locomotive, but the tanks on the through locomotives have a capacity of 6000 to 7000 gal.

Various expedients for lessening the ram have been discussed with the railroad officials. There are summarized and commented on by Mr. Saville as follows:

(1) By a slower motion valve on the standpipe. This is objected to by the railroad people on account of delay to train service. (2) The use of a water cushion valve on the standpipe which would act similar to the air checks on doors. This device is now in operation in various places and when new works very satisfactorily. After constant use, however, the parts wear and if repairs are not made the conditions of ram become as bad as before installation. (3) An air-pressure tank or chamber may be installed so devised that theoretically at least the shock of the quick-closing valve will be mostly taken up by an air cushion. Such a device is in operation in several places, but it is understood to be not entirely satisfactory. This condition may be due, however, to a defect in installation rather than being inherent to the system. (4) An elevated and independent tank may be used, and this from a water-works standpoint is probably the most satisfactory solution of the problem. In this case the water may be drawn out as quickly as desired and the tank refilled by a steady stream that will be automatically and gradually cut off as the tank is filled. Unfortunately this method of solving the problem is not always feasible either on account of esthetic conditions which forbid an unsightly tank or on account of the cost of an architecturally satisfactory structure.

Effect of Steam Fire Engines

Water ram caused by steam fire engines forms an interesting study. On Dec. 13, 1912, at 2:15 a.m., an alarm sounded for what it was feared would prove to be a bad fire. Four steamers responded; two with a capacity of 1200 gal. per min. and one of 900 and one of 600 gal. capacity. In addition, some near-by fire pumps were put in use. These hose lines were laid: Two 3-in., four 2½-in. and three 1½-in. lines. A Venturi meter indicated that 350,000 gal. of water were used at the fire. The rate per hour during 16 periods of 10 min. each increased from 125,000 gal. for the first to 240,000 gal. for the fourth period and then showed a general but not uniform decline to 110,000 gal. for the ninth period, a rise to 140,000 for the eleventh period and a decline to 30,000, 20,000 and 30,000 gal. for the 14th, 15th and 16th periods, respectively.

The accompanying diagram was reproduced from a recording pressure-gage chart taken at the water office, 500 ft. from the location of the fire. Mr. Saville states that "the gage and the steamers were on the same main or on closely cross-connected parallel mains in the same locality as the fire." The "extreme length of vibration corresponds to about 110 lb. per sq.in." The falling-off in range of vibration at 3:15 a.m. corresponds to the withdrawal of some of the fire engines from the scene of the fire.

Quoting now the concluding paragraph of Mr. Saville's paper:

In connection with this diagram it may be of interest to state that the city of Hartford has recently passed through a rather disturbing period due to low rainfall and the excessive calls that have been made on the storage in the reservoirs. In order to take every precaution possible to conserve the supply and to put off as long as possible the evil day of turning to the Connecticut River for an emergency supply, the gates on the supply mains were throttled down during the later afternoon and night. The intention was to keep the pressure during this period at about the same point as it stood during the day hours of maximum consumption. A drop in pressure of about 15 lb. per sq.in. was made in this manner, and the Venturi meter records indicate a saving of at least a quarter of a million gallons per day.

By good fortune there are two fire engine houses not far from the city line and also near the main gates on the supply main. Two men were stationed at each of these houses, and on an alarm of fire they open the gates as soon as possible. A number of alarms have come in during this period, but at no time has there been any lack of pressure when the engines arrived. The ordinary night consumption at this season of the year is at a rate of about 4,000,000 gal. per day. The time of closing the gates appears on the diagram about 3 p.m., and the effect of opening up on account of other fire alarms the same night is shown at 8 p.m., 12:45 a.m. and 2.15 a.m. Ordinarily the gates are opened each morning at 5:30 a.m.

Surplus Waters of the Los Angeles Aqueduct

By Burt A. Heinly*

SYNOPSIS—The Los Angeles Aqueduct, having been built to supply the future needs of a large city, will provide a vast surplus of water for years to come. Two rival plans for selling this surplus are reviewed in this article: (1) The Mulholland plan, which proposes to sell water substantially at cost to irrigate land which, it is assumed, will ultimately become a part of the city; (2) the Graham plan, which proposes to sell water at the highest obtainable market price to a more remote district. Under (1) the area irrigated by the surplus water, it is assumed, would be gradually transformed from cultivated land to city lots, the volume of water required in either case being practically the same. Under (2) the irrigators would be compelled to find water elsewhere, as best they might, as soon as Los Angeles needed the water. The Mulholland plan is a scheme of coöperation with outlying districts to be brought into the city. The Graham plan is a strictly commercial proposition. The city authorities have adopted the Graham plan, but the plan must be approved by popular vote before it can be put into effect.

Today the Los Angeles Aqueduct system, by which the city of Los Angeles is to carry a daily water-supply of 258,000,000 gal. from the Sierra Nevada Mountains across the Mojave Desert and into the San Fernando Valley, a total distance of 234.7 miles, is practically completed. The latter part of March should see the new aqueduct, which is the longest† and in many respects the most remarkable in the world, ready for operation.

To many it will come as a surprise that for the larger part of the 20,000 miner's inches which the aqueduct is designed to deliver, no system of distribution mains have as yet been provided. It is the purpose of this article to take up in briefest detail the causes productive of this condition and then proceed to an examination of the two distribution plans proposed. It is believed by the writer that the exposition of each of the two propositions will be of interest to the engineering world: (1) because each is unusual from the end it is desired to accomplish; (2) because the conditions to be overcome are not to be met with in any project of its kind now on record, and (3) the magnitude of the proposed system involves a work comparable only to the reclamation projects of the federal government.

Primarily the Los Angeles Aqueduct is designed for the purpose of supplying with domestic water the city of Los Angeles and the surrounding towns which in time will become a part of the municipality. Ultimately, the entire flow of the aqueduct will be required for this purpose, but now and for some years to come, nearly nine-tenths of the whole flow may be classed as "surplus." In any section of the Eastern states this "surplus" would be classed as "waste" until such time as it was required for domestic consumption. In the semi-arid Southwest, however, this "surplus" when devoted to irrigation has a value second only to that of domestic use. Nowhere in the United States does water command so high a rental as it does in Southern California, as will be brought out by figures to follow.

Of the 195,000 acres of dry land contiguous to Los Angeles it was early estimated that approximately 135,000 acres could be irrigated profitably. Early in 1909 the preliminary engineering investigations were undertaken to this end. The subject received not only attention at the hands of the city's Board of Water Commissioners, but for a period of several months weekly meetings were held in the council chamber of the city hall, at which every citizen was given the fullest opportunity to express his views on the important subject. An account of this rather unusual procedure was published in Engineering News for Dec. 29, 1910.

By March, of 1911, the topographic surveys of the whole region contiguous to Los Angeles were completed and in that month a Commission of Advisory Engineers was appointed to make an investigation and report on all phases of the irrigation problem. This commission was composed of John R. Quinton, W. H. Code and Homer Hamlin, all of whom have been connected with many of the large projects of the United States Reclamation Service. This board filed its report in June, 1911, and its findings were practically in accord with the views of William Mulholland, chief engineer of the Department of Public Service and designer and constructor of the aqueduct system. (For a summary of this report see Eng. News, p. 514, Oct. 26, 1911.) The map of the districts selected by the board is herewith presented (Fig 1), because it plays an important part in the discussion to follow.

Soon after the report had been filed, the Board of Public Service, either through death or by resignations, was almost entirely changed in its membership. Mr. Mulholland was requested by the new board to file with it his own plan of distribution with an estimate of the cost of the system. This was done on Mar. 16, 1912. As to the area to be covered it coincided with the report of the Advisory Engineers, the acreage and districts being somewhat changed as shown by Fig. 2.

No one of these reports definitely included water distribution in the San Gabriel Valley. Mr. Mulholland was instructed to prepare plans and estimates for this district, S. C. Graham, one of the new commissioners, believing that there lay a rich field for the water in that direction.

The San Gabriel Region was selected by Mr. Graham for economic reasons, and the plan of distribution that he has devised and proposed is called the Graham plan. This includes a conduit called the "High Line" (Fig. 3), to be built at a cost of approximately $5,250,000. Some time within the next few months the city will be asked to vote bonds for the installation of the distribution system according to the plans of Mr. Graham.

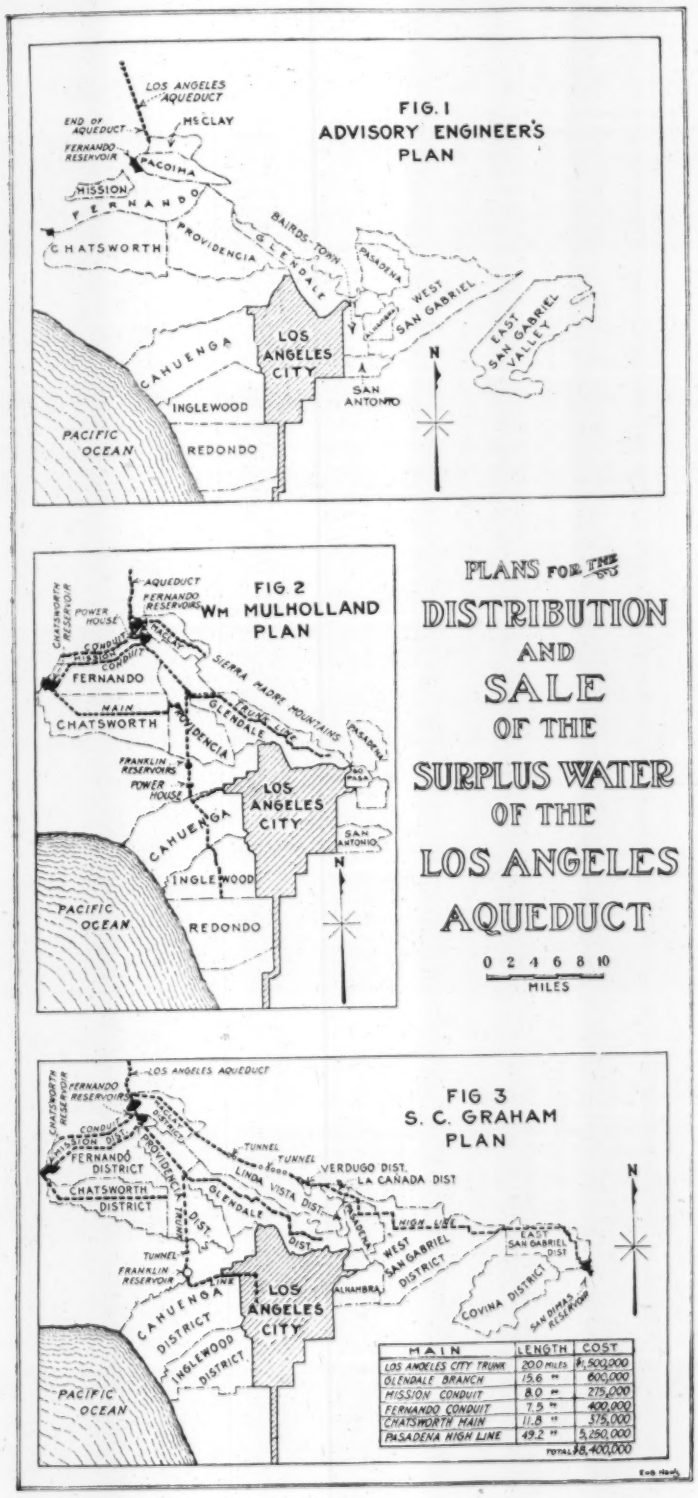
Anticipating that the city will at least vote bonds for the purpose of delivering aqueduct water into the city, the Board of Public Service is advancing $1,500,000 out of the revenues of the Water Department to construct a pipe line with a carrying capacity of 7500 miner's inches* from the aqueduct outlet to connect with the

*636 South Hill St. Los Angeles, Calif.

†The Coolgardie pipe line Western Australia, is 351.5 miles long, but it is a 30-in. steel main, through which water is lifted 1290 ft. by means of eight pumping stations.—Ed.

*A California miner's inch is 12,960 gal. per day.

present distribution system in the western part of the city. Of this quantity, Los Angeles will at present require 2000 miner's inches for domestic consumption. It is expected that the quantity in excess of this amount can be sold to other and smaller communities and to prospective irrigators along the line where it passes through the Fernando Valley and in the Cahuenga District. This



line is called the Frankiin Cañon pipe line, and the work of construction is now under way.

A year of drought is (Feb. 7) apparently in prospect.* While the Franklin Cañon pipe line can not be completed to connect with the distribution system during the coming summer, it can be finished as far as the point where it crosses the Los Angeles River. Here the water, temporariiy, may be emptied and be taken into the city's present supply mains, which are adequate for the purpose, so that possible water famine may be thus averted.

Other than the Franklin Cañon line, no work on the distribution system is under way. If the people approve the Graham plan by voting bonds, then the long and difficult tunnel work (there is a single tunnel with a length of 3½ miles) on the High Line, designed to carry 11,000 miner's inches, will require at least three years for its completion. [Bond election called for Apr. 15; see news notes page, this issue.—Ed.]

The Advisory Engineer's Plan—Let us first review the original plan of distribution for the reason that it entered primarily into the plans under which the aqueduct enterprise was projected and afterward undertaken. Naturaliy, the disposition of the surplus water received more than the usual amount of study and investigation because the city's engineers faced problems in irrigation entirely new to the science. In a nutshell, the great problem was how and where to build an irrigation system so that with the growth of population, automatically and with no hardship, it would become insensibly a domestic water-supply system. This was not so difficult as it first appeared. By more than a year of tests in various residence sections of the city it was found that a miner's inch, or a flow of 12,960 gal. per day, sufficed for 7.77 acres of city dwellings and gardens, the sprinkling of streets, fire protection and sewer flushing.

By a most fortunate coincidence, the same quantity of water, continuous flow, provides irrigation for 7½ acres of land given over to the cultivation of citrus trees. The problem in the main, therefore, resolved itself into anticipating the growth and direction of population, setting aside districts in anticipation of this growth and applying the water to these districts. As the city extends its boundaries the acreage nearest the city's center in course of time becomes so valuable that horticulture is unremunerative, the acreage is subdivided into city lots and the water which formerly nourished vegetable growth is diverted to the purposes of domestic supply. This same transition as it applies to the present water-supply has gone on in the city of Los Angeles for many years and was brought to an end within the past decade entirely for the reason that the present water-supply had reached the point where it was inadequate to meet the demands of domestic use.

In following this law of the city's growth as it applies to the water-supply, there is no shifting of economic conditions, no lawsuit over the most troublesome and entangling phase of legal procedure, water rights, and no section is made to revert to non-productiveness by reason of the transfer of water from one locality to another. This plan, then, looks forward always toward the end for which the aqueduct was constructed, namely, to provide an adequate domestic supply for several millions of population. Irrigation in this plan is held to be only the temporary disposal of the present 18,000 miner's inches of sulplus water. As a part of this plan, the Advisory Board of Engineers recommended that the San Fernando Valley, which lies to the northwest of the city and below the mouth of the aqueduct and its storage reservoirs (Fig. 1), should be made a part of the proposed area of distribu-

*This fear was removed by extensive rainfall late in February, 1913. The rainfall from July 1, 1912, to Feb. 7, 1913, was 3.11 in., against a normal of 8.89. By March 1 the seasonal rainfall had been increased from 3.11 to about 12 in.

tion. From the position of the valley the board believed that as much water as should be required should be applied there, (1) because of its juxtaposition to the aqueduct—it was so situated geographically that the distribution system could be built at the minimum of cost; (2) because in the anticipation of obtaining water the great ranches of from 15,000 to 40,000 acres were being broken up into 1-, 2-, 3-, 5-, 10-, 15- and 20-acre tracts and population was trending in that direction. And what was much more important, they reasoned that if the quantity they had assigned to the district were taken up the return water, which ultimately would find its way through the gravels into the Los Angeles River, thence into the conduits of the city's present supply system, would amount to 4000 miner's inches. This supply, they stated, could be applied to the major part of the Redondo and Inglewood Districts (Fig. 1).

In summation, the board made its report on the assumption that the municipality should not place itself in the position of a private public-service corporation bargaining and selling its commodity at the highest possible rate, irrespective of the future growth of the city and the purposes of the aqueduct. On the contrary, the board, if not openly, at least in so many words, implied that the distribution of the surplus is a present means to a future end, the profits to the city during the period of surplus to accrue from the city's use of the water in power development as it passes through the aqueduct, from the indirect wealth that comes to a city in a large suburban population and from the capitalization of the irrigation water at a fair rate of interest over the cost to the city of carrying the water from the Sierra Nevadas to the lands in question; these lands to be contiguous to the city and of an area not greater than the assignment of one miner's inch to 7½ acres. Competition by prospective water-users, it will be seen, does not enter into the plan.

Soon after the board had reported the members were requested to file a supplementary report with reference to the application of the water in the San Gabriel Valley. This was done, it being pointed out that there would be an additional cost of distribution, a loss in power development, as the water must be taken out at an elevation of 1461 ft., or at the very outlet of the aqueduct and above the last power drop, and that there would be little or no return water in seepage for use elsewhere.

The Board of Engineers further recommended that the water should be applied solidly, that is, one miner's inch to 7½ acres, with no scattering, the ultimate use of the water being always held uppermost. It was suggested in this connection that the rates should be reasonable, so that it would be advantageous for whole districts to take the water. The Board of Engineers made no recommendation as to rates, but merely stated that 20,000 acres in the Riverside citrus belt, one of the richest and most valuable horticultural sections in the world, paid $12.65 per acre per annum. This is at a rate of very slightly more than 1c. an inch per hour, or 1.86c. per 1000 gal.

The Board of Engineers recommended that the districts themselves should finance the construction of the distributing systems, either by the formation of irrigation districts under the California law or by any other means that would be sound and feasible, and thereupon be annexed or consolidated with the city. The pipe lines were to be constructed by city engineers and were then to become the sole property of the municipality. They believed that at a favorable rate the water would be purchased solidly in the districts where the city most desired to have it, but they made the provision that if irrigators held out for a lower rate than was equitable to the city, then it was within the city's power to carry the water into other less favorably situated districts where the city would be met with fairness; for, they said, "the municipality is under no obligations whatsoever to furnish irrigation to any district or area."

THE MULHOLLAND PLAN—With a statement concerning Mr. Mulholland's report on distribution, we shall be ready to pass on to a discussion of the Graham plan, which is distinctly new in its application to the sale and distribution of water designed to be used in irrigation.

Mr. Mulholland, in his report of Mar. 16, 1912, submitting plans of conduits and pipe lines with estimates of costs, followed closely the plan of the geographical distribution as proposed by the Board of Advisory Engineers as well as the means by which it should be brought about, i.e., annexation of the districts in which the water is distributed with the districts defraying the entire cost of installation. (See Fig. 2 for Mulholland plan.)

With reference to the construction of the distribution system and the area to be covered, Mr. Mulholland made the following statement:

> With the exception of the permanent structures of concrete, the tunnels and reservoirs and the pipe designed for the city's use alone, the mains should be designed of a capacity sufficient only to supply one-half the water that will be ultimately required, if distributed at the rate of one miner's inch to 7½ acres. The purpose of building the pipe lines on this basis at first is that much of the land to be covered is at present but sparsely settled and it is but natural to expect that the accretion of population will be gradual, and that a very considerable time must elapse before an amount in excess of half of the ultimate needs is required. When the time arrives that this first system of pipes shall be outgrown, the water users will then probably be better able to add a duplicate system, which may or may not be laid along the lines covered by the system here proposed. This duplication will add safety to the works and obviate the immediate large expenditures necessary to build the pipes of full capacity, as well as saving deterioration on the second half to be built. This practice is one usually followed in water-works construction and has been notably successful in operation of the present works of the city of Los Angeles.
>
> In point of fact, the capacity of the pipes here proposed will be able to supply water at the rate of one miner's inch to each ten acres and it may be twenty years or more before any increase in this capacity will have to be provided. The rate of 1 in. to 7½ acres, figuring for the year round, makes liberal provisions for any conditions that may arise as to the character of development, and is the rate recommended by the Board of Engineers who carefully considered and reported on this matter, and is based on a very broad experience in Southern California.
>
> It will be observed that no line is proposed to convey water to Pasadena or the territory lying easterly therefrom, the reason for this omission being that Pasadena has made surveys of her own for this purpose and carefully prepared estimates thereon. The San Gabriel country lying to the east of her borders can only be reached from the aqueduct by passing through the city of Pasadena, involving the acquisition of a right of way and the tearing up of the streets. It has always appeared to the writer that the only solution of the problem presented by this difficulty is, that if the San Gabriel country is desirous of procuring Owens River water, it should be annexed to the city of Pasadena and move jointly with her in the matter, that is, providing, of course, that Pasadena herself will want the water.
>
> Surveys have been made and complete data collected for the building of a line both to Pasadena and the San Gabriel country by this department, but the cost of such lines seem too excessive to be undertaken by the city of Los Angeles. Indeed, the question is still an open one as to whether the city should undertake the building of any lines for the terri-

tory outside her borders other than that intended for the city and which will be exclusively devoted to the city's use within her present limits.

The construction for a half supply as outlined by Mr. Mulholland, according to his estimates, would cost $3,401,000. The construction of the lateral system he discussed in the following paragraph:

The design of the network of distribution pipes to be attached to these main pipes must be left to the future, as much of the land proposed to be covered is still unsubdivided, so that no outline of streets exists. It is possible, however, to make a reasonably close estimate of cost. Assuming average ideal conditions, this cost may vary widely, in accordance with the purpose and quality of the work. A grid-work of sheet-steel mains of ample capacity for irrigating or domestic purposes can be constructed in accordance with the figures herewith presented. A complete grid-work of sheet-steel pipe can be constructed over almost any given area embraced by these districts for about $35 per acre, the mains to be one-eighth of a mile apart, or on a system of 660-ft. squares. Ideal construction of cast iron with all appurtenances required in densely peopled towns, such as fire-hydrants, street-sprinkling hydrants, etc., involves an average expense, under southern California conditions, of about $125 per acre. The soil conditions of most of the country that will be served by this system permits of the free use of sheet-steel pipe. There are a few restricted localities, however, where sheet steel would not be found durable. This is a minor matter, however, as it would be many years even under adverse conditions before renewals would be required.

The Graham Plan—Commissioner Graham's plan, as it has been set forth by him and as it has been indorsed by the Board of Public Service Commissioners and by the City Council, takes the fullest cognizance of the economic use of the surplus aqueduct flow as irrigation water *per se*. Mr. Graham holds "that where one has something thing to sell, he attempts to secure for it as large a market as possible, the idea being that if the demand is in excess of the supply, all the supply can be disposed of and at a very much better price than if the supply is equal to or in excess of the demand.

Therefore, the Graham plan provides that the water shall be carried to points covering as large an area as it is possible to reach (Fig. 3). Competition among land owners can only be brought about by distribution over an area intentionally much larger than can be served in order to get the highest profits from water sales. The application of water to dry land increases the value of the land from $300 to $500 an acre and the municipality is justly entitled to as much of the unearned increment as it is able, through competition, to wrest from the land owner. There is within the irrigable area of every district a portion of the land generally least productive without water that is most productive when irrigated. For this reason the increase in the production of wealth brought about through the use of aqueduct water will be greater if the area covered by it is larger than it can supply.

By an economic law, the water must find its way to land the productiveness of which will be most greatly increased by using it, for this land is able to offer the highest price for the water. And the prosperity of the city will be best assured by having the water used on these lands of highest productivity. The Graham plan contemplates that it will make very little difference to the people living within the present limits of the city whether the water is used within the city or in territory contiguous to it, for it assumes upon present conditions within the city (large areas of vacant lots not built upon) that there never will come a time when all the land within the limits of the city will be using water and that this applies equally to any district outside of the city. On this account it is no more essential that there should be held a full reserve supply for contiguous irrigation districts than it has been necessary in the past that Los Angeles should have received a full supply of water for all the lands within the city.

The plan further provides that all the pipe lines, conduits, reservoirs, and appurtenances of the city should be built with the proceeds of bonds issued by the city and that the distribution mains and conduits of any considerable length should be constructed of a size sufficient to supply all the lands requiring water that could be reached in the direction in which the lines are being extended.

It is further assumed that the other plan proposed would require a generation before all the water were placed in service, whereas under the Graham plan, with a proper distribution system installed, Mr. Graham asserts that two to four times as much water would go into use when the distribution system is finished as would be the case if the distribution is confined to a limited area, and that within a comparatively short time all the water will be in service.

The plan contemplates the possibility of the ultimate withdrawal of the water from the lands on which it is originally placed. This is provided for by the fact that the owner of the land receives no title or right of ownership to the water. Under a form of contract, he will take the water at whatever rate may be finally determined, for a term of 15 years. (This is the longest period under the charter of the city that a lease of surplus aqueduct water can be made, and no right in fee simple can be given without a two-thirds vote of the people. It is not at all probable that the city will ever vote to give a right where the water is used for irrigation. Where the water is to be used for domestic purposes in towns contiguous to the city, as Pasadena, Santa Monica, Monrovia, etc., the exigencies of use would demand a right in perpetuity which the citizens of Los Angeles would probably be willing to give by vote.)

Within this period of 15 years, the city, at any time that it sees fit, may increase the rate of payment. The irrigator must then either meet the increased rental or surrender the water. It is provided, however, that the city shall not increase the water rate to exceed 10% during the irrigating season, i.e., between May 1 and Nov. 1. Upon any increase in rates, the irrigator, if he refuses to pay the higher rate, surrenders the water upon 30 days' notice.

The city agrees in the contract to deliver the water to mutual water companies within one mile of their central plant and to private water owners, not in any mutual company, within two miles of the land designated. It is further provided that the rate charged shall be the same wherever irrigation water is sold, irrespective of the cost of delivery through any individual line or conduit, there being one exception, which is that where the water is taken out above the lower aqueduct power drop, the irrigators shall pay an additional sum, equivalent to the value of the horsepower that is lost.

It will be seen from the foregoing that by the Graham plan, the least productive lands will be unable to pay the increased premium and will revert to their former dry state, while the water will henceforth be devoted to the higher use of domestic supply.

Opponents of the Graham plan assert that no irriga-

tor can be treated fairly if his water-supply is taken from him after he has once started to use it, for a considerable investment will be lost when the person making it is deprived of the water.

Mr. Graham answers the argument by asserting that this is true only of orange, lemon and deciduous lands where the cost of planting is considerable and where the lands must be cared for during a period of years before a revenue is secured. He asserts that where the water is used in the production of field crops no particular investment is required, and if it is ever necessary to remove the water from such lands, the loss involved will be slight. Even so, both the city and the consumer will have benefited because of the temporary use of the water on the lands to the extent that a greater amount of wealth has been produced than if the water had not been in service for that purpose. As to orchard lands, the hypothesis is made that the removal of the water is so remote as to be hardly worthy of consideration, or if it is granted for the sake of argument, at least a life time must elapse before any water applied to citrus lands is needed for domestic consumption.

Under the Graham plan the city council has set the official rate at 2c. per in. per hour, or $23.36 per acre per year, on the basis of 1 in. to 7½ acres. To show the very high value of water in Southern California many irrigators in the basin of the San Gabriel are signing contracts at this rate with the pro rata of lost power production added. The locality is by far the richest and most valuable fruit-growing district adjacent to Los Angeles. The water-supply of the valley, even by the driving of wells, is insufficient to cover the area of arable land. Wherever water is available it is devoted to the irrigation of citrus groves, which in truth have been extended beyond the capacity of the water resources of the valley.

To reach the dry lands of this valley it will be necessary to build a pipe line high along the base of the Sierra Madres, at a cost of $5,250,000. This conduit would supply Pasadena, but for many miles between the outlet of the aqueduct and the San Gabriel Valley the character of the country through which it passes precludes the use of any large quantity of water in irrigation. This High Line, as now located, has a length of 48 miles and is designed to carry a maximum of 11,000 miner's inches, or more than half of the normal flow of the aqueduct diverted from a drainage area which might give a proportional return of several thousand inches of ground water.

The Graham plan, however, does not admit this loss of return waters as a financial loss to the city. It makes the assumption that the high rates obtained by use of the water in the San Gabriel Valley will more than remunerate the city in point of money, over that suggested by the Advisory Engineering Board through the use of the water in the San Fernando Valley. Used high in the San Gabriel Valley, the same percentage as in the San Fernando will sink into the gravels and be drawn off by ranchers lower down, once and in decreasing quantity possibly a second time. Thus the city profits not only directly from the higher sales of water, but it profits largely, although indirectly, from the prosperity of those who recover it without paying tribute to the municipality.

It will be seen that the success of the Graham plan depends upon the construction of the High Line into the San Gabriel Valley and the possibility of making all the other sections pay the same rate as can there be obtained.

The city in setting two cents as the official rate has not done so without the power of revision. That the rate will not be increased at this time is a foregone conclusion, but the Council may lower it if the price is found too high for the economic disposal of the whole quantity.

In the San Fernando Valley and sections other than the San Gabriel Valley there has been little disposition on the part of irrigators to sign contracts. They make the claim that only in exceptional cases of citrus lands under high cultivation can they hope for a profit where the water rental is $23.36 per acre per year, and that much of their lands are unfitted by reason of lower climatic conditions for the growing of citrus trees.

The foregoing comprises a fair review of the whole situation as it exists at the present time. Whatever may be the outcome, Los Angeles, in the satisfactory disposal of the surplus waters of the aqueduct, with the heavy attendant expenditures for a distribution system, faces a problem hardly less vital or important than the one with which she was confronted in 1905 in the construction of the comprehensive Owens River supply system that is now on the eve of completion.

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Reinforced-concrete Trolley Poles in Cleveland*

By L. P. Crecelius†

The subject of concrete trolley poles has received attention by the Committee on Power Distribution of the American Electric Railway Engineering Association, and a report has been submitted. The information contained therein was mostly of an engineering nature as was to be expected; principally strength, sizes, etc., were treated. The discussion accompanying the report related for the most part to expression of doubt as to the ultimate life of this structure, especially, when viewed from the standpoint of electrolytic destruction of reinforcing steel used in the make-up of all concrete poles. In short, little confidence was expressed as to the durability of this pole and considerable criticism was advanced against its use by representatives of the lighting interests because of possible danger to linemen. Therefore, the installation of concrete trolley poles upon a rather comprehensive scale by a large and important railway company in the face of the above may be interesting.

For more than two years the Cleveland Ry. Co. has been using concrete trolley poles; at first only to replace old wooden poles in the outlying districts and later in practically all new work, with the result that now over 750 poles of this character are in service. The reason for this may be of interest. The poles were introduced on the system at the suggestion of J. J. Stanley, the president of the company, who became interested in poles of this character some three years ago, because of the neat appearance of the structure.

In the beginning, only 50 poles were made and placed in the streets experimentally. At once they received favorable public comment. The neat appearance of the drab colored octagonal pole in the street in great and favorable contrast to the old, crooked, wooden poles in use, together with the dark and colored steel poles, appears to have been responsible for this feeling, and it soon developed that whenever new work was encountered the request for concrete poles followed.

In the work shown in Figs. 1 and 2, the use of poles in the district was forbidden, in fact within two years' time all poles were required to be removed by ordinance, the cables to be placed under ground. However, by agreeing to use concrete poles, the right was received to install poles instead. Thus the advantage of the concrete poles over its predecessors on this score was pronounced; coupled with the fact

*From "Aera," the monthly publication of the American Electric Railway Association, issue of February, 1913.

†Superintendent of Motive Power, Cleveland Ry. Co., Cleveland, Ohio.

of low cost of manufacture and maintenance we have (waiving for the time being consideration of ultimate life) at last a serious competitor to the old types of poles used in carrying overhead wires and cables.

A short description of the standard concrete poles used by the Cleveland Ry. Co. may not be amiss. The length is 28 ft.; diameter at butt, 11 in.; diameter at top, 6 in. The shape is full octagonal, commencing 6 ft. from butt. The butt is square. The finish is a natural cement color. The weight is 1700 lb., and the poles are safe for a 500-lb. pull at the top when set 6 ft. in the ground—with large margin for safety. The cost of manufacture is $12.

In the effort to prevent possible electrolytic destruction of steel, only porcelain insulators are used, safe for 6000-volt service, both for feeders and span wires.

Fig. 3 shows the yard in which all poles were made. The great and burning questions, "How long will the pole last and how will it behave in severe wind and sleet storms"?, as yet remain without an answer. However, the following conclusions are borne out by this short experience.

FIG. 3. YARD FOR MANUFACTURE OF REINFORCED-CONCRETE POLES, CLEVELAND RAILWAY CO.

(1) The pole is received favorably by the public.

(2) The pole is immeasurably superior in every respect to wooden poles for railway work.

(3) They cost considerably less than tubular steel poles.

(4) They apparently require little or no maintenance.

The specifications for manufacture follow:

SPECIFICATIONS FOR CONCRETE TROLLEY POLES

The concrete for poles shall be composed of one part by volume of packed cement, to three parts of gravel and sand conglomerate.

The cement shall be portland cement and conform to the specifications of the American Society for Testing Materials.

All sand and gravel shall be sound, hard, and not contain soft shale or other injurious or decayed matter.

All gravel and sand shall be entirely free from loam or clay and kept clean at all times.

Gravel and sand shall be of rounded shape, the aggregate to be graded from largest size of gravel downward to the smaller grains, the large to predominate and shall just pass a 1-in. square mesh sieve. Tests shall be made on samples for maximum specific gravity and for minimum of voids, both before determining on the grading, and also at frequent intervals as required during construction.

STEEL REINFORCEMENT—The steel reinforcement shall consist of eight ⅝-in. square twisted bars placed 1 in. from concrete surface to center of (or axis of) steel bars.

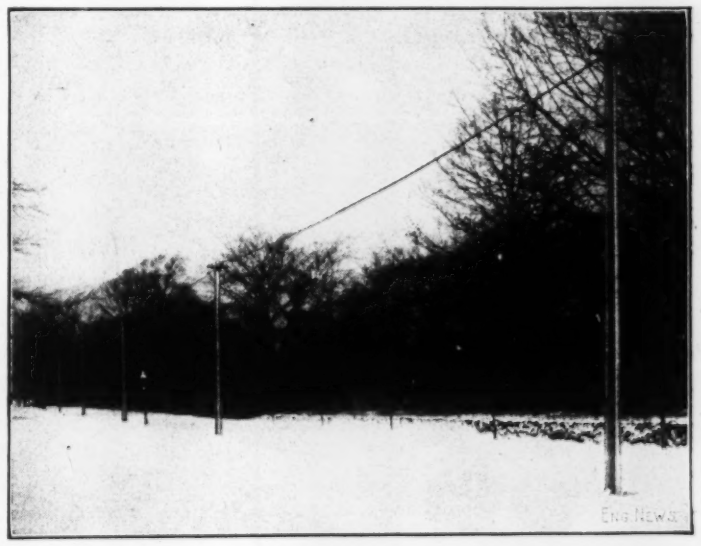

FIG. 2. RAILWAY FEEDER-LINE CONSTRUCTION

FIGS. 1 AND 2. STANDARD REINFORCED-CONCRETE POLES USED IN CLEVELAND, OHIO

Bars shall be kept in exact place with wire or spacing material.

Each second bar shall have hook shaped ends, returned 12 in. after bending around with a 4½-in. radius for bottom end, and 2-in. radius for top end. Returned ends shall be securely coupled with wire to the unbent end.

Tangent of bends shall be about 3 in. from end surface of concrete.

PROPORTION OF WATER—The proportion of water for mixing shall be such that the concrete shall not be so wet as to let the cement settle, but wet enough to mold readily against the steel and forms.

The concrete shall be poured into the forms with the utmost care, for non-disturbance of steel and forms, and for keeping uniformity of mixture from end to end without leakage, and obtaining true straight lines and smooth exposed surfaces.

REMOVAL OF FORMS—Forms shall not be removed prematurely nor shall the handling of the casted concrete while seasoning be such as to cause initial and destructive strains.

SEASONING—During the first period of 28 days of seasoning the cast poles shall be kept continuously and uniformly wet by some approved sprinkling system, that can be perfectly controlled and regulated.

SUPERVISION—The contractor or his foreman shall give his entire personal supervision to the work.

INSPECTION—The contractor shall permit the railway company's engineers and all persons appointed by him to visit and inspect the work at all times and places during the progress of work, and shall give every required assistance for such inspection.

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Lock Gate Erection Progress at Panama is reported as follows, in the "Canal Record" of Feb. 19:

All the material for the lock gates has been shipped from the shops of the contractor in the United States, and the last delivery should be made on the Isthmus this week.

At the end of January the gates were 68% erected, 51% riveted, and 5% finished, the state of completion at each lock being:

	Gatun	Pedro Miguel	Miraflores
Erecting	78	82	43
Riveting	66	70	15
Finishing	10	..	..
Number of leaves	40	24	28

Work is in progress at Gatun on all of the 40 gate leaves, at Pedro Miguél on all of the 24 leaves, at Miraflores on 20 of the 28 leaves. During January the progress was better than during any previous month. The number of rivets driven in January, the total driven to Feb. 1, and the number yet to be driven are shown in the following statement:

Locks	Driven in January	Driven to Feb. 1	Remaining to be driven approximately
Gatun	269,372	1,590,600	819,400
Pedro Miguel	152,279	980,000	420,000
Miraflores	119,568	261,000	1,479,000

Practically all the men operating riveting machines are negroes. The hand riveting is done by white Americans. The total force at work on the gates in January was 514 Americans, and 3371 negro laborers.

Concrete Bank Protection for Deep Rivers

By B. Okazaki*

SYNOPSIS—In Engineering News, *May 16, 1912, p. 922, Mr. Okazaki described an experimental stretch of mattress river-bank protection, in which the mattress is formed by threading together into a mat a number of reinforced-concrete blocks, 6x6x24 in. in size. This article took up only the protection of shallow rivers. In the present article he describes some further work on a deeper river, where the problems of laying the mattress were somewhat more complicated.*

The experimental concrete mattress work on the Yubari River, which was described by the writer in a previous issue of Engineering News, was all laid in shallow water. At this location where the water in its low stage is about 4 ft., the placing of the mattresses is easily accomplished by means of the simple free-log scaffold, which was described in the previously noted article, and the mattress may be laid at once for its full width. For additional protection, a horizontal apron some 6 ft. in width may be added to cover the river bottom in front of the bank to be protected as an extra protection against future probable scour. This would be laid in addition to the width required to cover the entire slope of the bank below low water down to the deepest river bottom. In such a case the upper portion of the bank, which is sometimes not covered by the mattresses in use in the writer's work, may at the same time be protected by any kind of covering. When work is to be done in deep water, however, the case is entirely different and the difficulties in setting the mattress markedly increased.

The setting of a concrete mattress on the bank of the Ishikari River, having more than 40 ft. depth of water at low stage, is probably the first attempt at such construction. Indeed, the application of the concrete mattress for the protection of a caving bank of a river having such depth is one of the most careful operations required of river engineers. This is particularly so when the mattress is first set down with a minimum width, or, in other words, when the so called trial method is adopted. In such a case the mattress with a preliminary small width is sometimes subject to an expected, but sudden and violent, settlement after it has been set in place, owing to the subsequent severe caving of the bank at the foot of the mattress. Usually there is no protection work provided for the uppermost portion of the bank, and so the mattress is left merely resting on the middle portion of the bank to wait for further natural dislocation.

The original setting of a mattress for the estimated full width in deep water is very costly and may involve the expense for a width which will not be needed. It is for this reason that the writer has adopted the trial method, that is, it is the practice to set the mattress bit by bit according to the demands of nature, mainly depending upon the natural action of the caving bank, and paying only for the width which is really necessary for the site at the time of placing.

The mere setting of the mattress for a width as great as 36 ft. is easily done by means of the pontoon-hung scaffold described in the previous article. With a slight improvement in this scaffold even a mattress as wide as 45 ft. may, with not much difficulty, be set in deep water. However, a close watch is required to supplement this width at the upper edge in order to follow the settlement of the mattress as the lower part of the mattress settles. The extent of the settlement of this mattress may be sometimes as great as 20 ft. in one flood, particularly where the bank and bottom of the river consists of very fine sand lacking any coherence. To meet and manage such violent settlement of any structure is an arduous

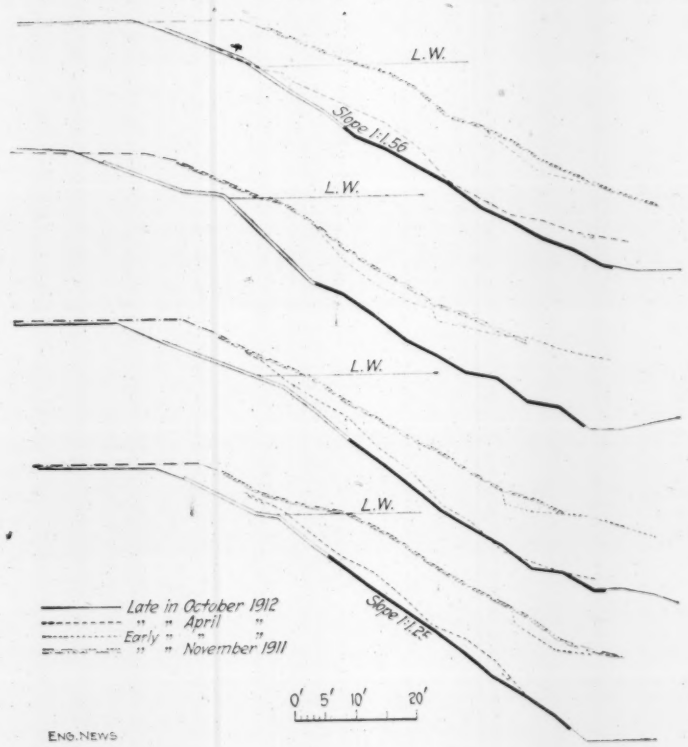

Fig. 1. Cross-section of Ishikari River Bank, Showing Settlement of Mattress

task. No one can be more active and vigilant than the engineer in charge of such work.

Take for example the case of the concrete mattress bank-protection work of the Ishikari River at Bannaguro. Below are given the results of comparative surveys made particularly for the purpose of ascertaining the occasional changes in the mattress work after remarkable floods. This bank-protection work was placed for a distance of about ½ mile. The accompanying Fig. 1 shows three typical sections taken at ken* 130 to ken 160. The work was placed in October, 1911, and the three sections show the condition in November, 1911, April, 1912, and October, 1912. Floods occurred in April and October, 1912. From these sections it will be noted that the mattress has nearly reached the deepest river bottom of 30 ft. below low water, and that the maximum total width of the mattress now amounts to 93 ft. That is to say that the mattress has almost satisfactorily settled down to its final position by the natural sinking down, and, by occasional additions on the upper edge of the width of the mattress successfully prosecuted by the

*Chief Engineer, Ishikari River Improvement Works, Sapporo, Japan.

*1 ken = 6 ft. nearly.

proper management of the resident engineers, the mattress has been fitted to the bank soon after the caving of the latter.

As a matter of investigation, if the progress of the settlement of the mattress is traced by measuring its horizontal and vertical dislocation separately, it will be found that the horizontal dislocation may take place in two ways, as shown by the positive and negative signs in the summarized table herewith. A positive translation means the dislocation forward, that is, toward the thalweg, and a negative translation means the retrograde dislocation or a motion of the mattress back to the bank. The negative dislocation of the lower edge of the mattress usually takes place when the upper edge of the mattress is anchored, or when the friction between the mattress and the bank is greater than the natural force tending to make the mattress slide and sink down. In this case the lower portion only of the mattress bends down, and hence back, to fit into the gap behind produced by the severe caving or scouring of the river bed. As to the vertical dislocation there is no negative or upward motion of the mattress, which is as it ought to be. The maximum horizontal translation of the lower edge of the

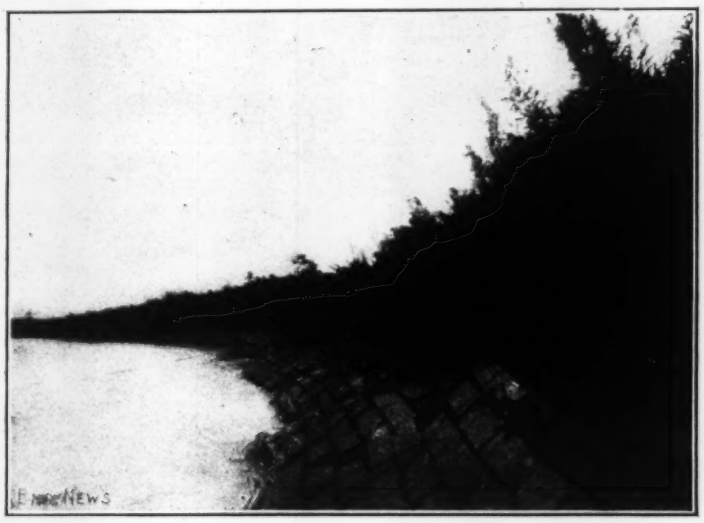

FIG. 2. VIEW OF CONCRETE MATTRESS, SHOWING WILLOW GROWTH IN ONE YEAR

mattress of 22.2 ft. occurred at cross-section 140 ken. and the maximum vertical translation of 22.5 ft. occurred at cross-section 160 ken as may be seen in Fig. 1.

SUMMARIZED TABLE SHOWING THE TRANSLATION OF MATTRESS

Cross-section at *	Horizontal translation of the upper edge of mattress, ft.	Vertical translation of the upper edge of mattress, ft.	Horizontal translation of the lower edge of mattress, ft.	Vertical translation of the lower edge of mattress, ft.	General slope of the mattressed bank at present	Remark
40 ken.	6.5	3.0	7.3	7.8	1/1.25	General slope of the mattressed bank is measured between the low water surface and the lower edge of mattress.
50 ken.	1.3	1.0	—3.2	4.0	1/1.15	
60 ken.	0	0.5	0	0.8	1/1.40	
70 ken.	—1.0	2.2	—2.4	2.4	1/1.37	
80 ken.	8.3	4.0	2.0	12.0	1/1.22	
120 ken.	8.0	12.6	5.2	16.4	1/1.33	
130 ken.	12.0	16.9	11.0	18.3	1/1.63	
140 ken.	22.4	21.0	22.2	20.3	1/1.47	
150 ken.	21.2	18.0	19.2	18.8	1/1.53	
160 ken.	17.3	14.6	13.0	22.5	1/1.30	

* 1 ken = about 6 ft.

When the mattress has moved to such an extent as to allow its lower edge to touch the bottom of the thalweg, the bank may be considered to have assumed a stable condition and the upper portion of the slope of the bank which is not covered by the concrete mattress may be then protected by any kind of pitching. In a section of the Ishikari River the upper portion of the bank has been protected by riprap placed within the 3-ft. square panels made by the willow mattress (described in the previous article in ENGINEERING NEWS), and the willow has grown in one year after the fence was made to the extent shown in the halftone in the view in Fig. 2. Thus the bank in question has become completely protected both above and below the water surface.

CONCLUSIONS

From the foregoing it may be concluded that, (1) in some cross-sections the mattress has by itself nearly reached to its final destination so as to need very little further supplementing of the width; (2) in general the slope of the mattressed bank is left flatter by nature after the severe caving when the mattress (set at first with only a slight width) makes a positive or forward translation, than when its lower edge makes retrograde translation; the stability of the protected bank is insured more in the former case than in the latter; (3) the setting of the mattress may better be made at first with a slight width, as the best economy may be accomplished in this way when only so much of the mattress width is added bit by bit as is really necessary for the site in question, thus avoiding the costly setting at first of the full width of mattress down to the bottom of the thalweg; (4) it is wise to leave the upper portion of the slope of the bank unprotected until it may safely be protected by any kind of pitching work, after the protection of the lower portion has attained its perfect state, although sometimes temporary protective works are placed for the upper portion of the bank at the same time as the first width of the mattress is set. This is done when too much caving of the naked upper portion of the slope is to be avoided, before the completion of the bank protection.

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The Quartz-tube Mercury-vapor Lamp, which was developed in Europe on the principles of the ordinary mercury vapor lamp (see "Engineering News," Sept. 12 and Dec. 5, 1907), has been introduced in this country by the Cooper Hewitt Electric Co. It will be recalled that the standard mercury-vapor lamp runs at a vapor density equal to a pressure of about ⅛-in. mercury column, while in the quartz-tube type the pressure may run up to atmospheric or higher. As the potential per inch of length of the mercury-vapor column is great in the quartz-tube lamp, a short tube is necessary. On account of the high temperature of the mercury vapor in this type the lamp has also a minor continuous spectrum in addition to the characteristic bands of the mercury vapor, there are thus more of the red and orange rays than in the common lamp. As the ultra-violet rays of the mercury arc are readily transmitted by quartz, this lamp would be injurious to the eye unless guarded. A satisfactory screen for this undersirable radiation is secured by using a surrounding globe of clear glass. This, together with the metal casing for the mechanism gives the device the appearance somewhat of an ordinary arc lamp.

Two types of the quartz-tube lamp are found in the American line, one for 110 and one for 220 volts, direct current. For alternating-current supplies, the direct current must be secured from a rectifier or converter. In the one type, the tube is held in an aluminum support, which is pivoted and connected with a tilting lever linked up with the armature of an electro-magnet. The burner, magnet and resistance coils are all connected in series and with the lamp at rest the tube is inclined, so that mercury bridges the electrodes. When current is turned on, the magnet moves the tube until the mercury column is broken and an arc starts. So long as current continues, the burner is held in this running position. In the second type, for the higher voltage, the tube is in the same position burning as at rest; in starting, the mercury bridge is formed by a shunt magnet which tilts the tube. When the electrodes are short-circuited, a series magnet breaks the circuit of the first magnet, and allows the burner to drop back to its original position, breaking the mercury column and starting the arc.

A Compact Sand and Gravel Washing Plant

About a mile north of the city of Peekskill, N. Y., on the east bank of the Hudson River, there is a large sand and gravel bank, the location of which offered unique opportunities for developing a washing and shipping plant. The property under development covers 112 acres, located on a hill, the highest part of which is some 252 ft. above the high-water level of the river. One of the new state highways runs through the property and the greater part of the washing and screening plant is located in a tunnel under this road. The Hudson River is something over a mile distant, but a connecting creek borders the property, in which a channel 110 ft. wide and 11 ft. deep at low water is being dredged. The distance of the loading wharf from deep water in the river is 1¾ miles.

From numerous test borings over the entire area there is good reason to suppose that nearly the whole hill is composed of sand and gravel, with almost no large stones or boulders. There is a hogback running lengthwise through the area, outcropping in places, but not so located as to offer a serious obstacle to development work. The sand and gravel is of excellent quality, and except for a thin top soil of loam contains but 2 or 3% of waste, and is about 70% gravel. It is proposed to excavate the hill with steam shovels, which will load into dump-cars hauled by Shay-geared locomotives.

The washing plant, shown in Fig. 1, is located on the state highway, about in the middle of the property. The dump-cars from the sand bank in the rear are dumped directly into a hopper, and the material flows by gravity into a 2-in. mesh revolving cylindrical screen 5 ft. in diameter and 12 ft. long. The material which does not pass this screen falls into a 10x12-in. jaw-crusher having a capacity of about 20 tons per hour.

The outputs from the screen and crusher fall through chutes upon three deck-shaker screens, the first 2 ft. wide by 74 ft. long with a 2-in. mesh, the next below, 2 ft. 9 in. by 72 ft., with a 1½-in. mesh, and the bottom screen 3 ft. 6 in. by 70 ft., with a 1-in. mesh. These three screens are on a pitch of ½ in. to 1 ft., and are superimposed one above the other so that the material passing one falls below to the next, which is 9 in. wider in each case.

The washing is done simultaneously with the screening. Water is pumped from an inlet at the wharf by an electrically-driven centrifugal pump having a capacity of 1000 gal. per min., into a 6-in. main which extends on the center line through the top of the concrete tunnel containing the shaker screens. The pipe is perforated at frequent intervals and the water falls through the screens, carrying the waste material to the bottom of the concrete tunnel, where it is flushed by means of a 4-in. extension, from the end of the 6-in. main to the bottom of the tunnel, into a concrete settling basin, shown in Fig. 2.

The tunnel containing the screens, shown in profile in Fig. 2, is built of reinforced concrete, with inside dimensions of 9x7 ft., giving ample room for workmen to move alongside the screens if the occasion requires. The floor of the tunnel has a total fall of 3 ft. in 79 ft., or 1 ft. in 36 ft. Fig. 3 shows the location of the crusher and revolving screen with respect to the center line of the tunnel. The lower end of the tunnel, as already mentioned, leads into the reinforced-concrete settling basin where the final separation of the sand and loam takes place by gravity.

The waste material washed from the sand in the settling tank flows off the top of the tank and runs through

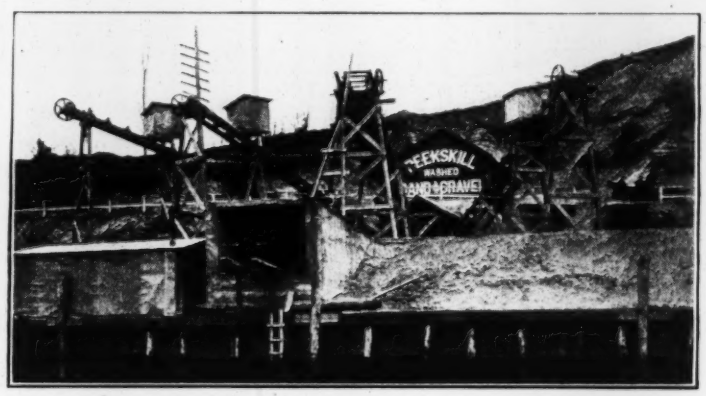


FIG. 1. SAND AND GRAVEL WASHING AND SHIPPING PLANT, PEEKSKILL, N. Y.

an 8-in. discharge main by gravity to a fill which is being made above the wharf.

The three shaker screens discharge at their lower ends upon as many 24-in. belt conveyors which diverge from the lower end of the screen tunnel in different directions, Fig. 4, and unload the different sizes of gravels upon storage piles on the concrete wharf, from a height of 24 ft. The sand after settling to the bottom of the concrete tank is scooped up by a 36-in. scraper flight conveyor and discharged into a storage pile near the middle of the concrete wharf. The belt conveyors are driven by individual

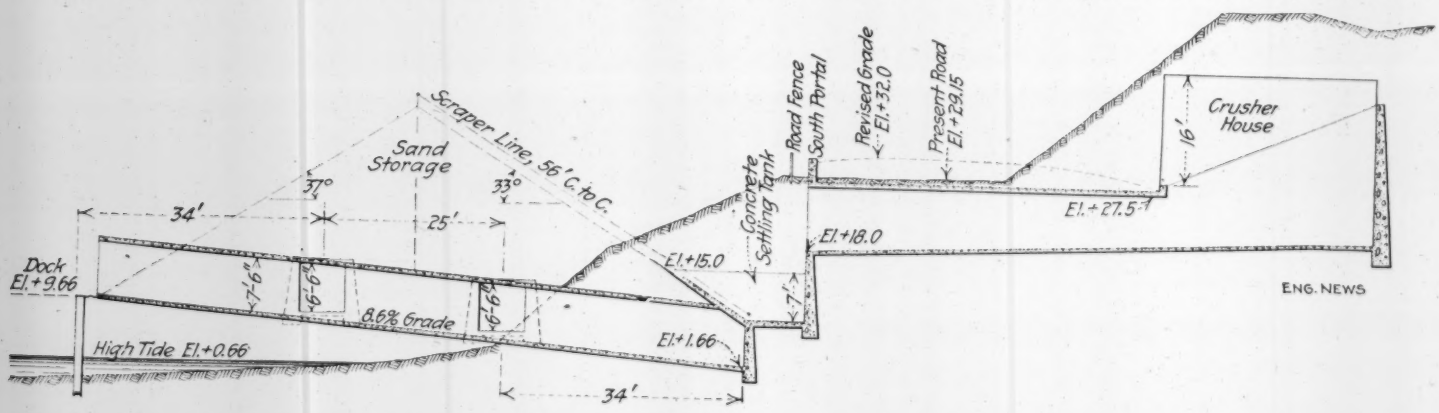


FIG. 2. PROFILE OF SCREENING AND WASHING PLANT OF THE NATIONAL SAND AND LAND DEVELOPMENT CO., PEEKSKILL, N. Y.

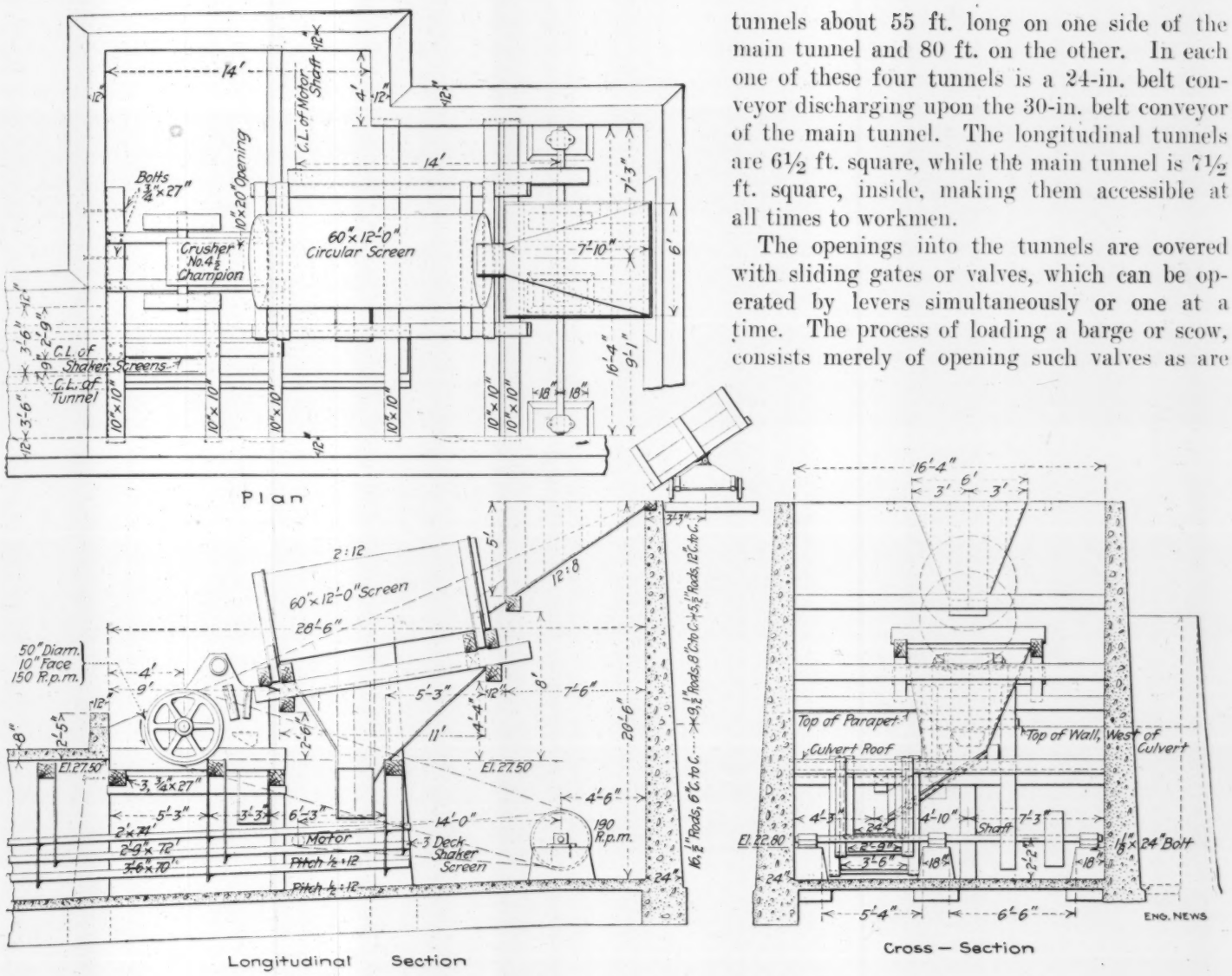


FIG. 3. PLAN AND ELEVATION OF CRUSHER AND SCREENS

20-hp. alternating-current motors, housed at the upper end of each conveyor frame.

Beneath the reinforced-concrete floor of the storage piles is a series of concrete tunnels which have 20x20-in. openings on their center lines under the sand and gravel piles. Through the middle tunnel, 76 ft. long, crosswise of the wharf, runs a 30-in. belt conveyor, 90 ft. long, which discharges over the end of the wharf directly into scows alongside. Intersecting this main tunnel on each side, and 25 ft. between centers, are the two longitudinal tunnels about 55 ft. long on one side of the main tunnel and 80 ft. on the other. In each one of these four tunnels is a 24-in. belt conveyor discharging upon the 30-in. belt conveyor of the main tunnel. The longitudinal tunnels are 6½ ft. square, while the main tunnel is 7½ ft. square, inside, making them accessible at all times to workmen.

The openings into the tunnels are covered with sliding gates or valves, which can be operated by levers simultaneously or one at a time. The process of loading a barge or scow, consists merely of opening such valves as are necessary to give the desired material and allowing the sand and gravel to flow from the piles to the belt conveyors below, by which the material is automatically transported and discharged into the scow. The loading capacity of the conveyor system is 500 cu.yd. per hour.

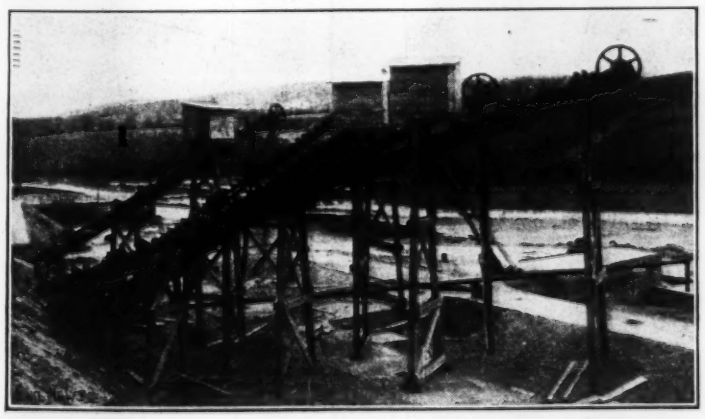


FIG. 4. BELT CONVEYORS FOR TRANSFERRING SAND AND GRAVEL TO STORAGE PILES

The plant is remarkably compact and easy of operation. It is designed to have a capacity of 2000 cu.yd. per 10-hr. day with an operating and excavating force of eight men. All the power used is electricity, at present purchased in Peekskill, but ultimately it is intended to have a power plant on the works. The plant cost complete $82,000, of which $20,000 represents the cost of dredging the channel.

The plant was designed and built by George C. Hudson, General Manager of the National Sand and Land Development Co., of Peekskill, to whom we are indebted for the foregoing data and plans.

Corrugated Iron Pipe for Storm Sewers was the subject of an inquiry in our issue of Feb. 13 (p. 324), and we are informed by the National Corrugated Culvert Mfg. Co., of West Berkeley, Calif., that there are many storm sewers of corrugated pipe made of American "ingot iron." At Berkeley, Calif., there is a 30-in. pipe 600 ft. long, while at Taft, Calif., there is a 12-in. pipe 1200 ft. long, both of which are said to be giving satisfactory service. At El Paso, Tex., a 24-in. pipe 3700 ft. long, has been built as the outlet of a sewage-disposal plant. This line has several bends, a short drop of 3½ ft. and a long curve.

Twin Falls—Oakley Irrigation Project

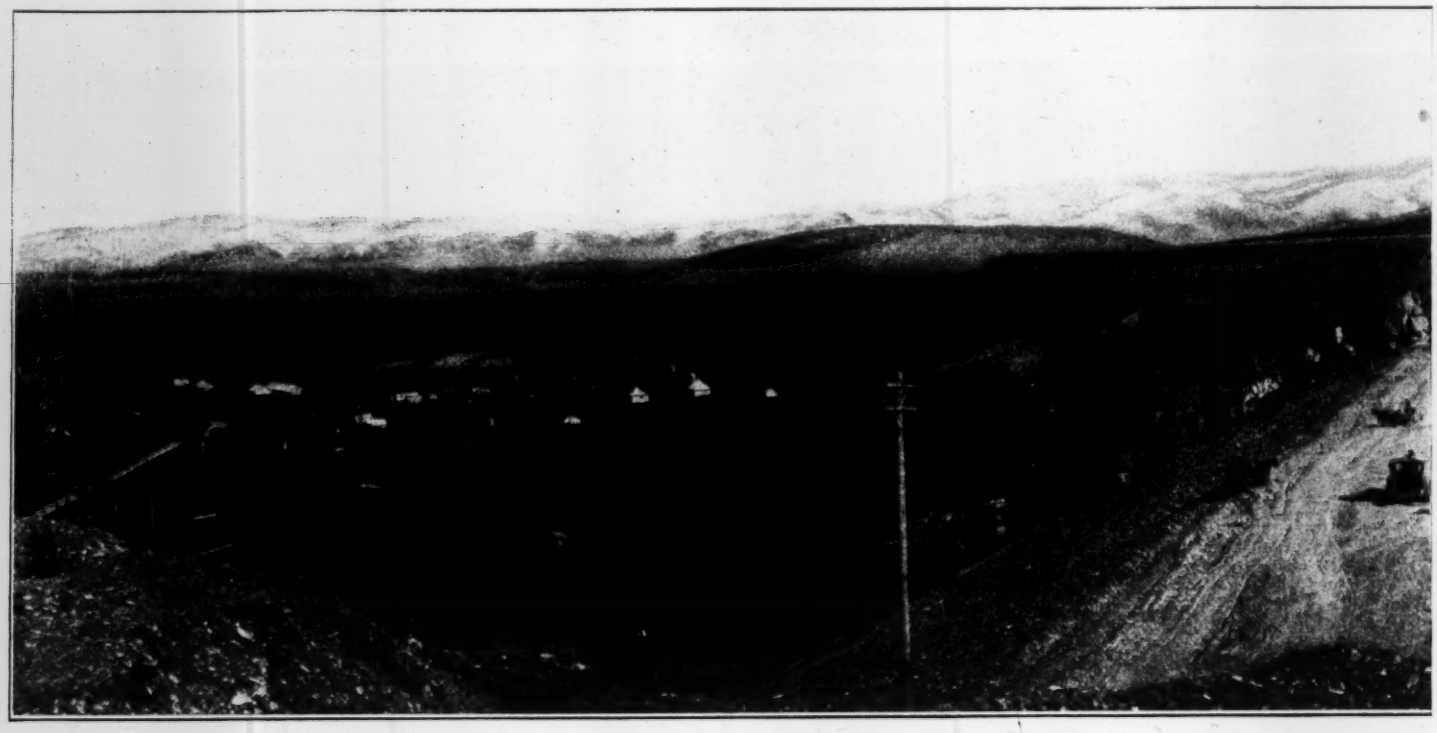
By A. M. Korsmo*

SYNOPSIS—An unusually high earth dam, 145 ft. high from the creek bottom to the top of its crest and containing more than a million yards of earth, had, as its most notable construction feature, motor-driven belt conveyors to transport the larger part of the earth fill. Two steam shovels, working at different levels, lifted the dirt into dump cars drawn by dinkey engines. These moved the dirt a half mile to a loading hopper which discharged onto a 250-ft. conveyor on a 3.5% grade. The dirt then passed, successively, to a 680-ft. conveyor on a 16% grade and to a level belt conveyor 900 ft. long. These conveyors were of rubber, 36 in. wide. The last conveyor dumped into a storage bin, from which the dirt was discharged through two chutes into dump wagons. The dirt was dumped onto the dam in windrows, from which it was leveled by ploughing lengthwise and using tongued scrapers. The 6-in. earth layers were sprinkled and rolled. The concrete core-wall, from 9 ft. above the natural surface, was only 1 ft. thick, but it was reinforced with meshed wire. The core-wall extends to bed rock, 40 ft. below the natural surface. The outlet tower and gates have interesting features.

The Carey Act irrigation project described in this article is located in Cassia County, southern Idaho, about 30 miles east of Twin Falls.

Leading Features—The main features of the project are (1) an earth dam 145 ft. high, 1025 ft. long, and 750 ft. wide at the base, with slopes of 3 to 1 on the upstream side and 2 to 1 on the downstream side. The fill required 1,074,000 cu.yd. of earth; 65,000 cu.yd. of rock were used for riprapping the slopes, and 6200 cu.yd. of concrete in the core-wall. (2) The reservoir, which is in the natural cañon of Goose Creek, will have a length of 5 miles and an average width of ¼ mile, storing 74,900 acre-ft. of water. (3) A spillway at the west end of the dam, in solid rock, with capacity for 2000 sec.-ft. The spillway lip, which follows a contour, is 600 ft. long and the total excavation in the spillway cut is 25,000 cu.yd. (4) A concrete-lined outlet tunnel, 870 ft. long, 8 by 10 ft. in section, and driven through solid rock under the cliff at the east end of the dam. Two indepenent types of outlet gates are used, one the standard sluice gate, the other of the tower type. (5) The water stored comes from four creeks. Goose Creek and Trapper Creek, which runs into it, are impounded by the main dam. Cottonwood and Birch creeks require diversion dams and feeder canals leading to the main reservoir. These feeder canals total twenty miles in length and include earth and rock ditches, tunnels, flumes and concrete inclines or drops. (6) The distribution system includes 150 miles of canals and laterals and covers a segregation of 50,000 acres of land.

The duty of water is fixed at 1½ acre-ft., actually delivered. The land has a very gentle slope, the laterals following the section lines to a considerable extent. The average elevation of the tract is 4600 ft. above sea level. The average annual precipitation for the last 15 years was 9.1 in. (7) There are 870 sq.mi. in the drainage area, which is a part of the Columbia River Drainage Basin, located in Utah, Idaho and Nevada.



Panoramic View of Goose Creek Dam under Construction.

Construction of the Main Dam

The dam is located in the mouth of Goose Creek Cañon (see plan, section and profile, Fig. 1). At the east end the rock cliff stands almost vertical, while at the other end there is a much more gentle slope with bedrock coming to the surface. In the creek bottom, bedrock was

*Assistant Engineer, The Faris Engineering & Construction Co., Oakley, Ida.

found at a maximum depth of 40 ft., under strata of sand, gravel and boulders, with about 15 ft. of loam at the surface. The core-wall trench was dug first and a 3-ft. concrete wall built up from bedrock to 9 ft. above the natural surface, puddling in on both sides with selected material. A cutoff trench 10x10 ft. in earth section and 8x10 ft. in rock was dug at each end of the dam, about 100 ft., upstream from the core-wall. This likewise was back puddled with selected material. At the upper toe another cutoff trench was dug, this time to bedrock, with a 10-ft. base and 1 to 1 slopes in earth, and an 8x6-ft. section in rock at either end. An 18-in. concrete wall 3 ft. high was built in this trench and back puddled with selected material. On the downstream side a drainage trench 10x6 ft. in section was dug along the toe and backfilled with loose rock.

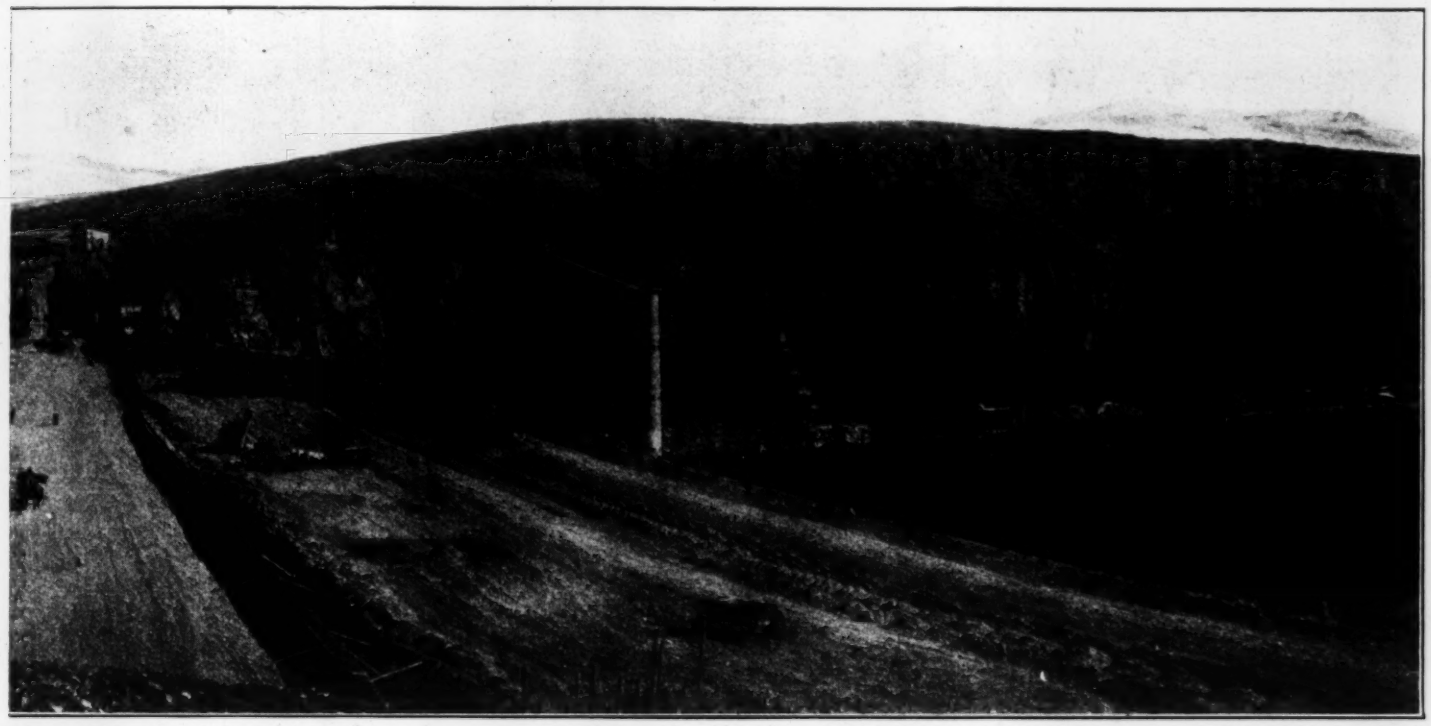
In the meantime the outlet tunnel was driven from four faces and the creek diverted through it. This enabled the core-wall and other trenches to be dug across the old creek channel and completed. Derricks and skips operated by teams were used in the excavation and wheeled scrapers carried the material away. This method proved efficient and good time was made, considering the large amount of water and boulders encountered.

The original plans called for a cutoff trench at the upper toe similar to the intermediate trench, but after encountering the large amount of sand and water in the core-wall trench it was decided to carry the upper trench to bedrock and put a small concrete wall in it.

The east cliff has a great many crevices and fissures in it. To guard against seepage through them the cliff was shot about 18 ft. back to give a solid bond for the core-wall. Three other vertical walls of concrete, each 1½x4 ft., were built about 15 ft. apart on the side of the cliff upstream from the core-wall, as an additional guard against seepage. All the crevices were cleaned out and back puddled with selected material. These cutoff walls were anchored to the cliff by ⅞-in. square twisted Ransome bars, grouted and wedged on 3-ft. centers.

The base of the dam was cleared of all brush and willows and ploughed to make a good bond for the fill placed on it. With the intention of sluicing the earth fill into place, the lower toe was built up about 20 ft., using wagons loaded from a near-by trap or loading platform.

Sluice flumes were built on the hill at the east end of the dam, on a 4% grade, with a 20-in. base paved with cottonwood blocks placed on end. Later this flume was changed to a 10% grade, same section, but lined with iron. The earth for sluicing was taken from a pit near the one used in 1912 and hauled by conveyors to the sluicing flumes. It was soon found that the sluicing method was impractical, chiefly on account of the lack of water, all of which had to be pumped from Goose Creek against a 175-ft. head. It was also found that the material from the borrow pit had a large percentage of black sand in it, which continually choked in the sluice flumes. Sluicing was then abandoned and preparations were made for building the dam by the mechanical



TWIN FALLS-OAKLEY IRRIGATION PROJECT, IDAHO

method, or by placing the material dry in layers, sprinkling and rolling it.

BORROW PITS—No borrow pits were to be found near-by which were high enough to allow dirt trains to run to the east cliff over the dam. Several small pits were found in gulches beyond the west end of the dam, but this material was a fine lava ash soil unfit for the body of the dam. Suitable earth was found about a mile east. It is a cemented gravel containing a heavy percentage of earth.

The following equipment was used in the pit to handle the material. Two No. 60 Marion steam shovels, three 16-ton Davenport dinkies and 50 4-yd. Western dump cars. Forty-pound rail was used both on loading tracks and main line. Lighter rails were unsatisfactory because they required constant surfacing.

From test pits it was found that the material would be very hard to excavate. The pit was then laid out so that the shovels worked on separate benches, giving each about a 20-ft. face. Considerable shooting had to be resorted to, even though neither shovel was ever required to dig its capacity. Shooting the material cost from 2

to 7c. per yd. Churn drilling and coyote holes were used, the former costing about 27c. per ft. The lower bench, where No. 1 shovel worked, did not require any shooting. Care had to be exercised that the material was not shot too hard, or it would sluff down on the loading track, besides making large chunks that could not be handled by the shovels or broken up at the loading hopper. The best results were obtained when just enough powder was used to loosen the bank and let the shovels break it up. On No. 2 shovel the teeth had to be changed every 6 to 10 days. Fifteen-car trains were used, one being in transit while the other two were loading.

Conveyors—The land adjacent to the dam site is very rough, having many deep gulches. To have moved the

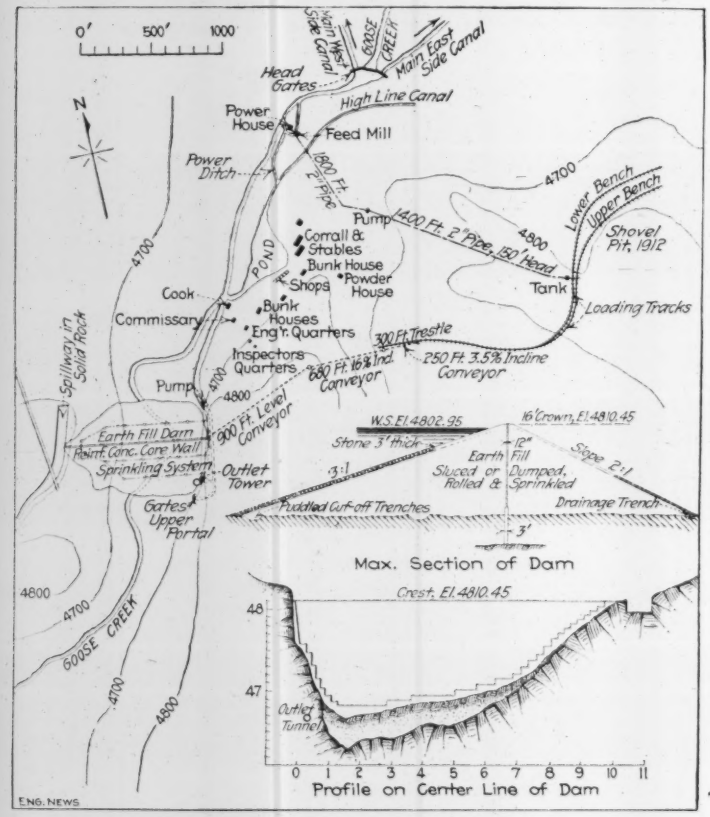


Fig. 1. Layout, Cross-section and Profile of Goose Creek Dam, Twin Falls-Oakley Irrigation Project, Idaho

material composing the dam by rail would have required miles of contour track laying. The location of a suitable borrow pit, as regards elevation, would have meant impossible grades for dinkey trains if bridges were built across the gulches. This led to the adoption of the conveyor system, as shown in the general plan, Fig. 1, and the views Figs. 2, 3 and 4. The three units are (A) a level conveyor 920 ft. long; (B) a 680-ft. conveyor on a 16% grade; (C) a 250-ft. conveyor on a 3.5% grade. These conveyors are built on trestles whose maximum height (Conveyor B) is 68 ft. at Mill Gulch.

In general, the bents have two posts, are on 24-ft. centers, and the stringers are on 42-in. centers. The head drive and tail-drum frames are anchored in concrete which is set on solid rock. The belts are of rubber, 36 in. wide and six ply.

When the dirt becomes wet in rainy weather it is very hard to handle it in the chutes at the dam. To avoid this difficulty as much as possible, and as a protection for the belts against the sun and wind, the conveyors were housed.

To take up the slack in the belts, which in the case of long belts is an important consideration, two types of idlers were used, one of the gravity type, the other of the "S" type (Fig. 5). Both were efficient, but the latter has an advantage where there is little underneath clearance. The belts are run on a speed of 450 ft. per minute and easily handled 750 4-yd. cars in a 10-hr. shift. This amount could have been increased 25% by speeding up the belts and loading heavier. The maximum output for both shifts was made in September, 1912, when 105,000 yd., measured in place, were conveyed. The average output for the season was about 95,000 yd. per month. The night shift handles about 90% of what the day shift does.

Power and Equipment for Conveyors—Conveyor A is driven by a 40-hp., 2200-volt, 60-cycle, 3-phase, type F.H., Westinghouse induction motor; Conveyor B, by a 75-hp. motor of the same type as the Conveyor A machine, and Conveyor C by a 30-hp. motor, also the same type as the Conveyor A machine. Running under no load the conveyor system requires about 50 kw., and when under full load from 100 to 425 kw. The variation is caused chiefly by the run-of-pit material, which at times has a great deal of gravel in it, and again may be all earth. The motors are started in succession, beginning with Conveyor A, a signal system being used by the motormen to communicate with each other. In this way the starting torque does not exceed 150 kw.

Current is brought from a hydro-electric plant on the Snake River, a 3¾-mile private transmission line being built from Oakley to the dam by the Construction Co.

Feed Hopper—A feed hopper of 300 yd. capacity is built over the end of Conveyor C (see Fig. 5). It has three compartments, with individual openings, so that the variation in pit material may be kept separated and conveyed to the dam as needed. The coarser material is used on the downstream side and the more select in the trenches and on the upper toe. A trestle alongside the hopper carries the dirt trains out on it so that they can dump into the latter.

A grid of parallel bars, 5 in. c. to c., with a slope of 4 to 1 down from the track, covers the hopper. The bars are ¾x4 in. in section and 24 ft. long. This grid separates all large rock and lumps of cemented gravel which cannot be broken up, and they are wasted on a near-by dump. As many as 18 men have been used here when the large cemented lumps came, but ordinarily two or three men could keep the bars clear.

The openings under the hopper are 1 ft. by 4 ft. wide, with no doors. Feed belts, 8 ft. wide of 30-oz. canvas, revolving under these openings, catch the material and drop it onto the conveyor belt. These three belts, which are independent of each other, are operated by chain drives and friction clutches from a line shaft which extends to the tail drum of Conveyor C.

Storage Bin—On the east cliff, under the head drive of Conveyor A, and on the center line of the dam, a storage bin is built with two chutes leading from it (see Fig. 2). This bin has a capacity of 200 yd. and was designed to provide for the fluctuation in the conveyor haul. The two chutes are built on trestles with a slope of 47.5 degrees and have a section of 20x22 in. They are covered with doors and lined on the bottom; one with

crescent-shaped iron castings and the other with 4-in. cottonwood blocks, set on end. Both chutes were satisfactory except that when the material got wet it would cake against the sides and bottom and the entire section of the chutes would gradually choke up. At such times it required from two to six men to clean out one chute while the other was being used. Because of this caking, which continued to a certain extent throughout the entire season, it was found that neither the iron nor cottonwood block linings wore down to any appreciable extent.

A portable hopper, with a capacity of eight wagon loads, was placed under the lower end of the chutes, which are parallel and 5 ft. apart. The dump wagons come under the hopper and are loaded. When running steadily four 1.5-yd. dump wagons are loaded per minute, one man operating the feed door of the hopper. Another man operates the chute gates, which are up under the storage bin, keeping the portable hopper full. At first the gates were placed at the lower end of the chutes and wagons loaded directly from them, but this proved very unsatisfactory, as the material would pack and choke in the chutes when the gates were closed. The material would not run smoothly, but moved in sections, one section making a heavy impact against the section below when it suddenly became released and slid down. As the fill of the dam raises, the chutes are cut off and the loading hopper raised.

Method and Sequence of Construction—From the portable hopper the material is hauled out and dumped in windrows parallel to the core-wall. Ploughing lengthwise and using tongued scrapers these windrows are leveled out to a 6-in. layer. The dirt is then sprinkled with water, using about 15%, and rolled with a 16-ton Avery traction engine. The rear wheels soon wore out, running over the loose uneven fill, and were replaced with Marion steam-shovel wheels, 24 in. wide and each weighing 1½ ton. The fill is laid on a 1.5% grade down from the loading hopper to the west end of the dam. This was done to help the stock in hauling loaded wagons, 16

Fig. 2. Dam under Construction, September, 1911

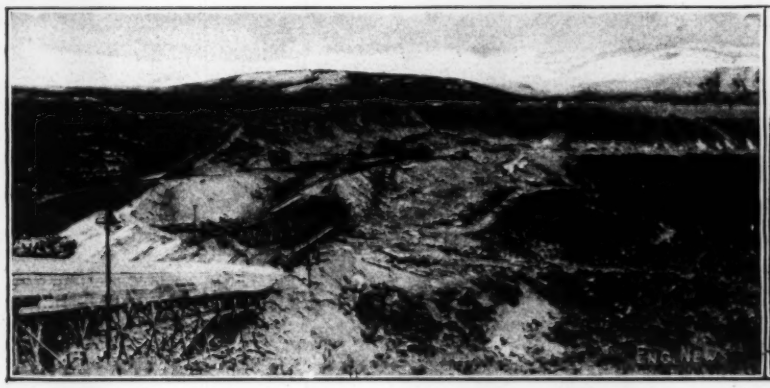


Fig. 3. Conveyors B and C, Feed Hopper, Dinkey Trestle and Cut to 1912 Borrow Pit

Fig. 4. General View of Conveyor System, Terminating at Right above the Storage Bin and Chutes Shown in Fig. 2

Figs. 2 to 4. Views Showing Construction Work on Goose Creek Dam, Idaho

teams being used per shift on an average run. The material is sluiced into place on either side of the core-wall, in the trenches, and also where the fill joins the cliff at the east end and the natural surface at the west end of the dam. The material is ideal for dam construction, and when sprinkled and rolled becomes very compact, due to the cementing qualities of the earth. The upper toe is built up of selected material for a distance of 20 ft. back from the face. This material, which is used along with the run of finer material from the shovel pit, is obtained from two small pits beyond the west end of the dam, using traps and a wagon haul. This material is a lava-ash formation, free from rock or gravel, and especially adapted for sluicing in the trenches.

Following the fill as it raises, the riprap is placed by hand, 3 ft. thick on the upstream face and 2 ft. thick on the downstream side. The stone is from ¼ to 1 cu.ft. in size, except a layer 1 ft. thick next to the earth on the 3 to 1 side, which is much smaller. The rock used is taken largely from the spillway excavation, although a terial. The reinforcing used is the American Wire Co.'s No. 9 mesh reinforcing wire, butt-joined and wired together. A portable half-yard Smith mixer, with self-charging skip and mounted on a wagon, is used. It is operated with a 7.5-hp. motor. Sand and crushed rock are used in proportions to get as dense and nearly impervious a concrete as possible. A crusher plant is operated in connection with the spillway excavation.

Reservoir Outlet Gates

The main sluice gates at the upper portal of the outlet tunnel are two in number, set 5 ft. apart on an incline of 45 degrees, and are 2.5x10 ft. in size. The gates are made of cast iron, heavily ribbed, and move on bronze slides. In closing them they are drawn tight by bronze wedges, three on each side of each gate. The hoisting devices are designed to operate against a head of 135 ft. The gate stems are 4.5 in. in diameter, with guides every 17 ft.

The tower (Fig. 6) is independent of the sluice gates. It is connected with the outlet tunnel, 150 ft. from the

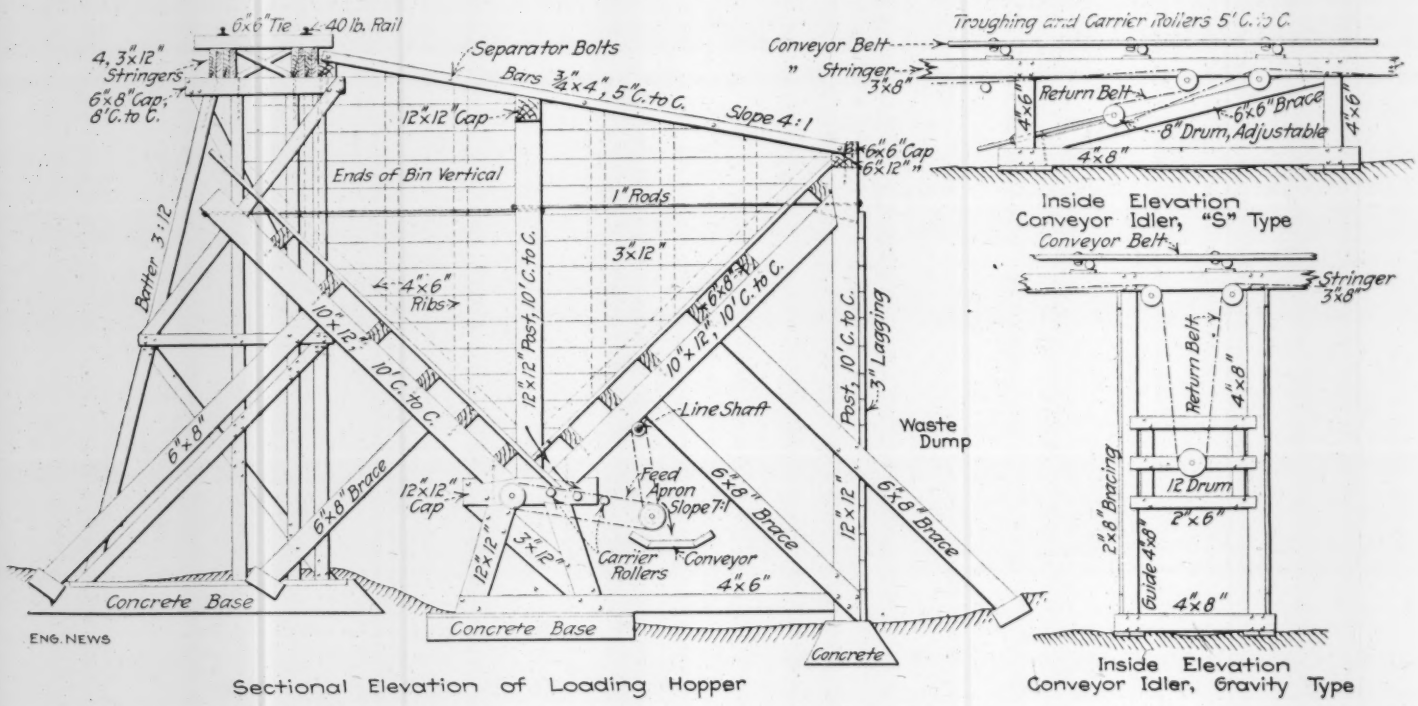


Fig. 5. Details of Loading Hopper and of Idlers for Conveyor System

considerable amount was shot down from the east cliff where it fell on the fill and was easily placed.

Sprinkling System—The pump for the sprinkling system is at the lower portal of the outlet tunnel. This pump is a two-stage, 3-in. American, pumping 100 gal. per minute against a 230-ft. working head, and requiring 25 kw. to operate it. A 3-in. main runs from the pump up over the east cliff. Three 2-in. pipes take out from it and are laid in the fill parallel to the axis of the dam (see plan, in Fig. 1). Two-inch standpipes are erected every 100 ft. on each pipe line and 3-ft. sections are added as the fill raises. Using a hose and nozzle, the entire surface of the dam can be easily reached from these standpipes. As an auxiliary, a triple plunger pump was installed on a pontoon on the reservoir at the upper toe, with a connection to the pipe-line system on the dam.

Core-wall—The 3-ft. wall was built from bedrock to 9 ft. above the natural surface, from which height the 1-ft. wall was built up, along with the dirt fill, in 34-in. lifts, this being the width of the woven reinforcing mapper portal, by means of a short tunnel 10 ft. long. A 20-ft. sump in the bottom of the tower provides against the impact of water falling from above. The tower is built of reinforced concrete, on a solid rock foundation, with three sets of ports, one above the other and 30 ft. apart.

Each set of ports has eight openings, 2x2.5 ft. in section, which are opposite in pairs. This arrangement destroys all impact of incoming water against the inside of the tower. Two cylindrical castings form the gate for each set, after the manner of the cylinder gate waterwheel. One of them is set in the concrete on the inner face of the tower and has the 2x2.5 ft. openings. The other, 3 ft. high, slides down into position just inside the outer stationary casting. Beveled bronze wedges make them fit water-tight when the gate is closed. Two stems are provided for each gate. The hoisting devices are on the top of the tower and are similar to those used for the sluice gates. The ports, being 30 ft. apart, make it unnecessary to operate any gate under more than a 40-ft.

head. Likewise, the big sluice gates at the upper portal need not be operated under more than a 60-ft. head. The tower and sluice gates were built and installed in the fall and winter of 1911-12.

GENERAL—Active construction of the dam was begun in May, 1911, but the trenches were dug and the sluicing method tried during the season of 1910. When work

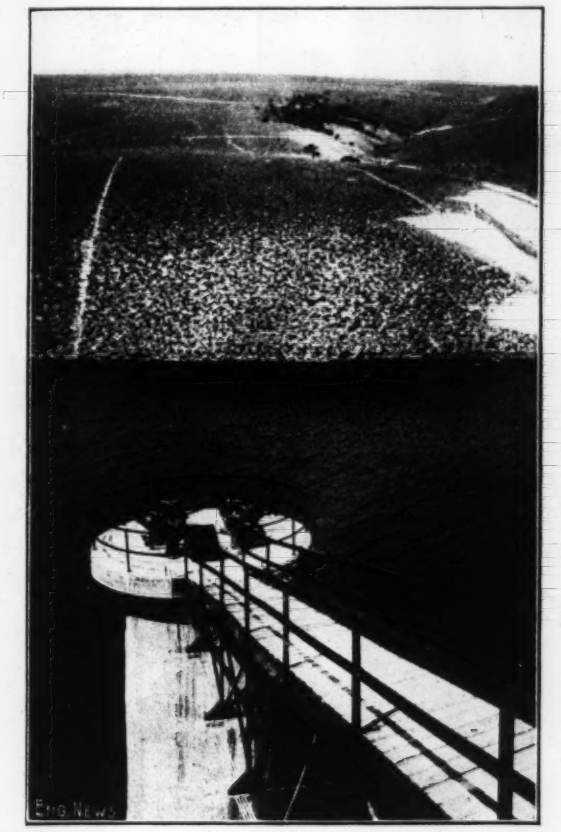


FIG. 6. TOP OF OUTLET TOWER, GOOSE CREEK DAM

closed down for the winter of 1912-13, there remained about two weeks' work (35,000 cu.yd.) to complete the dam. The distribution system for the project has been completed. By the close of December, 1912, 55 ft. of water was in storage in the reservoir, ready for use in 1913.

PERSONNEL—The Faris Engineering & Construction Co., of Boise, Idaho, are the engineers and contractors on this Project. R. W. Faris is president and chief engineer of the company. A. J. Wiley, of Boise, Idaho, is the consulting engineer and J. C. Porterfield is the construction engineer, the writer acting as his assistant. W. S. and J. S. Kuhn, of Pittsburgh, who have built a number of irrigation projects in this vicinity, are also promoting this one.

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Standards for the Hygienic Purity of Public Water-Supplies

Standards of purity for water and for sewage-works effluents have been sought long and ardently by many analysts and sanitarians. At the meeting of the Indiana Sanitary and Water Supply Association, held at Indianapolis the last week in February, 1913, J. W. Ellms* presented a paper with the foregoing title.

After mentioning the standards for laboratory analyses of water and of sewage formulated by a committee of the American Public Health Association (report printed in 1905) and revised some five years later, and remarking that laboratory technic did not stand still, as some feared, because standards were established, Mr. Ellms took up standards of purity for water. The remainder of his paper, except for one paragraph suggesting the need of state and federal enforcement of any purity standards which might be set up, and one on safe limits of bacterial removal, is as follows:

It is evident that unless there are fairly accurate methods of measurement for the purity of a drinking water, and that unless these methods are reasonably uniform, the results obtained will only lead to confusion and bitter disputes. The question, therefore, resolves itself into this form: Are our modern standard bacteriological methods sufficiently reliable to properly measure the hygienic purity of water? It is difficult to answer this question without qualifications. Without hesitation one may say, that as we can only find specific disease germs in natural waters with a great deal of difficulty, and that if found a knowledge of their number and virulency are of prime importance before the water can be absolutely condemned, it does not appear that our methods are as yet entirely adequate. On the other hand the circumstantial evidence easily and readily obtained by examining the water for the presence of organisms which may be and usually are associated with disease germs, would lead one to declare that some of our methods at least were quite sufficient to establish the degre of impurity which might exist.

It seems to the writer that if this subject of standards of purity is investigated in an open frame of mind, and with the same spirit of impartiality that the subject of standard methods of analysis was approached, it will be possible to establish tentative standards of purity. These standards will of necessity be subject to modification by local conditions, and may have to be frequently revised.

If it is kept in mind that a drinking water is hygienically pure when it does not produce disease nor disturb in any way the normal physiological processes of those who drink it, it will not be difficult to agree upon what shall constitute the safe limits of bacterial and chemical purity.

The writer believes that the angle from which the subject of standards of purity is viewed is of fundamental importance for a practical solution of the problem, and has endeavored to set forth this phase of the matter, instead of attempting to state what such standards should be. The whole question is one which is intimately related to the extent of permissible pollution of natural waters, and must be considered in conection with it.

By what method these problems shall be atacked is perhaps open to question; but the writer would suggest that it may be gotten under way by the appointment of delegates from each of our large engineering societies, water-works and sanitary associations, who shall meet to formulate a plan of procedure. These delegates may work in conjunction with any existing committees now in the field, or with any State or United States departments which have already given this matter attention.

Some of the points which such a body should discuss are:

(1) What diseases may be legitimately regarded as water borne?

This involves a consideration of the Mills-Reincke phenomenon and the Hazen theorem as set forth by Prof. W. T. Sedgwick and J. S. MacNutt, and the ideas of chronic intestinal tract infection advanced by N. S. Hill, Jr., and L. R. Whitcomb (see "Eng. News," Jan. 30, 1913), for it means a careful analysis of all the available and reliable vital statistics of those communities having impure water-supplies as well as those having pure supplies.

(2) A clear definition of what really constitutes a pure drinking water.

This means that much light is needed upon the relative numbers and kinds of bacteria, and of the nature and amount of the organic and inorganic matter which may be present in public water-supplies, and their significance in the causation of disease. It necessitates the examination of the available bacteriological and chemical data of public water-supplies, and its classification in relation to vital statistics.

(3) The selection of the maximum limits for the numbers and kinds of bacteria in a drinking water, and the permissible amounts of organic and inorganic matter which such a water may contain.

This selection, of course, will be the result of the logical conclusions reached from a study of the compiled statistics, and should be adopted only after a careful consideration and free discussion of the evidence.

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The Prevention of Missed Fires in Blasting

While electric fuses are generally recommended as the safest detonators for blasting operations, yet there seems to be some difference of opinion concerning the best method of connecting a number of charges which it is desired to fire simultaneously. In ENGINEERING NEWS, Sept. 22, 1910, there appeared an article on "Precautions for Maximum Safety and Effectiveness in Blasting," in which the statement was made that "electric fuses are connected in parallel sometimes for firing from lighting circuits," but that "when the source of current is a blasting machine or battery of the usual type, the bore holes should be connected in series," because "the common blasting machines and batteries will not satisfactorily set off detonators connected in parallel."

The apparent advantage of a series connection is that the charge has to pass through all the detonators in order that any one of them may be exploded. The great practical objection to this method, however, is the difficulty of making electric exploding cartridges of equal or nearly equal sensitiveness. In ENGINEERING NEWS of Jan. 25, 1906, there was described an improved form of electric exploder; but even in that type there is danger of inequalities in the periods of apparently similar cartridges. When a number of electric exploders are connected in series, it is true that the current passes through all or none of the cartridges (unless there are two or more grounds), but it is equally true that the exploding of the first charge may interrupt the circuit and prevent the exploding of the other charges. While it is not likely that the majority of cartridges of similar size and type would differ enough in period to be affected, it is easy to see how an occasional defective cartridge of abnormally long or short period might be used in such a series circuit and result in one or more missed-fire holes.

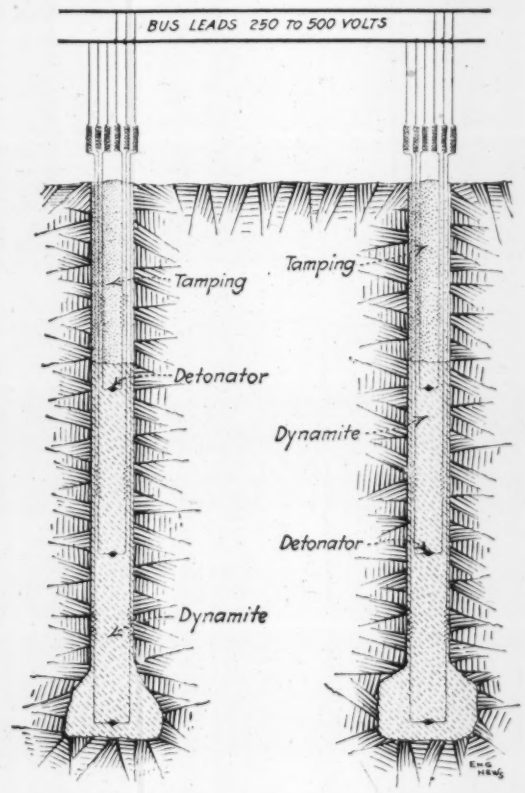
W. H. Mason, superintendent of the Edison Portland Cement Co., Stewartsville, N. J., in a paper read at the annual meeting of the American Society of Mechanical Engineers, December, 1912, advocated the use of parallel connections for firing a number of charges simultaneously. He also proposed the use of several detonators in each hole as an added precaution against missed fires. An abstract of the above mentioned paper is given in the following paragraphs:

A frequent cause of serious accidents in cement manufacture is the blasting methods used in the quarries. Many of these accidents are due to what is commonly called "missed fires," that is, charges which have been placed in the bore holes and have failed to explode under the usual firing conditions. Formerly when charges were exploded by time fuses these were probably more frequent than at present, when it is common practice to explode a series of holes by an electric battery, fuses being used only to explode the small "plug holes" or dobies, for the purpose of breaking large stones which have already been blasted from the ledge.

A missed fire is always a source of danger. There is no known way of unloading the hole safely and when an attempt is made to drill another hole near it, so as to blast it out, the drill bit not infrequently comes in contact with the dynamite in the loaded hole with disastrous results to the driller. When the driller is fortunate enough to get the hole in without accident, it is loaded and blasted. This usually throws the powder from the missed-fire hole among the débris and frequently when the latter is being loaded, a laborer will strike it with some tool and cause an explosion. The only way to avoid this danger is to prevent the missed fires.

For about eight years the Edison Portland Cement Co. has been exploding all churn drill blast holes with a 500-volt direct-current power circuit. Many of these blasts are made simultaneously on from 12 to 20 holes, each loaded with 500 to 800 lb. of 40% and 50% gelatin powder, and during this time there has been only one missed-fire hole. It was impossible to find the cause of this failure, but it was attributed to a poor connection from the exploder leads to the bus wires. Before this time, they had been using the common pushdown magneto machines—and it was a usual thing to have several missed-fire holes per month. One of the quarries of the company is so located that no power circuit is available and for a year or two the blasts were set off by push-down machines. After having had several missed-fire holes, and some resulting accidents, they installed a small 250-volt direct-current generator, driven by a steam turbine. This has been in operation several years and there have been no missed fires since its installation.

Gelatin powder is the most difficult of all the dynamites to detonate and it is a well known fact that if exploded by a powerful detonator, the full effect of the powder is obtained, while if improperly detonated, much of the effect is lost. For this reason and also on account of the danger and expense which always accompany a missed-fire hole, the writer believes it is better to use too many exploders, or electric fuses, of high power than not enough. In a 6-in. borehole, running 60 ft. deep, not less than three exploders should be used. One of these should be directly at the bottom, so that if when loading the hole with dynamite, a stone should slide in from the side and block it off, it would still be possible to explode the dynamite below, and thereby avoid the danger from the otherwise unexploded dynamite; the other two are distributed one near the center and the other near the top. All are connected directly across the 500-volt or 250-volt direct-current line, so that all exploders are in parallel and receive the full voltage of the power circuit. By this method any number of holes may be exploded at one time, up to the current capacity of the supply circuit. The cost of the extra exploders is always a small proportion of the cost of the dynamite used and the writer believes that this expense is warranted by the increased detonation power of the exploder, as well as by a sort of insurance against missed fires, which are always expensive aside from their potential danger.



CROSS-SECTION OF BLAST HOLES, SHOWING USE OF MULTIPLE DETONATORS

In the accompanying cut is shown the method of connecting the wires of the electric exploders to the bus wires. The argument has been advanced frequently that the insulation on the leads of the electric fuses is not sufficient to withstand the high voltage. This, no doubt, is true, but experience shows that the fuse in the exploder blows while the insulation is breaking down, and it is then a matter of no importance whether the insulation fails or not.

EDITORIALS

A Belated Reparation

It is now thirteen months since Messrs. C. G. Elliott and A. D. Morehouse, Chief and Assistant Chief, respectively, of the Bureau of Drainage Investigations of the U. S. Department of Agriculture, were removed from their positions on the charge of malfeasance in office. During all that time these men have been under the shadow of dishonorable dismissal; their acts have been the subject of a long-drawn-out Congressional investigation; they have been subjected to the disgrace of an indictment on criminal charges and they have suffered large pecuniary loss in injury to reputation and in expenses incurred in conducting their defense.

After a careful investigation of the charges against these engineers, this journal concluded that their offense at worst was a bookkeeping subterfuge, common enough in departmental circles and, in this particular case, approved by the auditors directly responsible. This opinion was confirmed by the investigation conducted by the Congressional committee, which, in August last, exonerated Messrs. Elliott and Morehouse of any criminal intent, and reported that their punishment had been unnecessarily severe. As a result of this report, the government authorities acknowledged their error to the extent of requesting the quashing of the indictment brought against the two men, but withheld the complete vindication of an immediate reinstatement. We now note in our "personal" columns on another page, a belated reparation. Almost the last official act of the 16 years' service of the Secretary of Agriculture, James Wilson, was the restoration of the two engineers to their original positions.

Whether this was in the nature of a deathbed repentance, or merely the celebration of the release from the sinister influence of his departmental Solicitor, McCabe, Mr. Wilson's act was one of simple justice only. We therefore pay the venerable and tenacious ex-secretary a dubious compliment when we say that we are gratified at his conversion—or his liberation as the case may be.

⁂

The Offer of a Prize for a Substitute for Gasoline

A good deal of publicity is being given to the offer of a prize of $100,000 by the International Association of Automobile Clubs for a fuel suitable for use in internal-combustion engines, the conditions being that the fuel must be less expensive than gasoline, must be readily procurable, and must be of such a nature that it cannot be "cornered" by trusts, national or international.

The prize might as well have been set at a million dollars or ten million dollars, for there is, so far as we can see, no possibility of its award. There are indeed other well known volatile hydrocarbons than gasoline which it is possible to produce chemically and mechanically. Benzol is a volatile hydrocarbon produced by distillation of coal tar, but the total amount which can be produced is trifling compared with the demand for a material to supplement the present supply of gasoline; and only when produced as a byproduct from coal can it be obtained at low cost.

Alcohol is a volatile hydrocarbon produced by the fermentation and distillation of vegetable growth. The limitations of alcohol as a substitute for gasoline are that the vegetable growth from the world's productive lands is already pretty fully utilized as food for man and domestic animals. While there has been much talk of processes of making alcohol from refuse vegetable matter, the final cost per gallon of alcohol produced by any such process appears to always work out far above present prices of gasoline.

We have now, however, exhausted the list of possible sources from which a volatile hydrocarbon may be derived; that is to say, it must either be obtained from liquid hydrocarbon (petroleum), which furnishes the present supply of gasoline, from the solid hydrocarbon, soft coal, which furnishes the benzol already referred to, or from refuse vegetable matter in the form of alcohol.*

It may be that the production of benzol may be increased. Such materials as lignite and peat may be laid under contribution to obtain it or some equivalent volatile hydrocarbon fluid. There may be some further development, also, of alcohol-producing processes. There is little hope, however, that any of these processes can so supplement the supply of gasoline as to prevent a steady increase in price. The two directions from which a check on the increase in the price of gasoline is most probable are, first an increased supply of petroleum, due to the stimulus upon production resulting from increased selling prices of crude oil and, second, and most important, the modification of the gasoline engine so that it can successfully burn heavier oils.

⁂

Point of Weakness in Low-truss Highway Bridges

The defects in design which are responsible for such truss failures as that of the Wellsville bridge (whose collapse is described on another page) are obvious, and it needs little more than examination of the sketch of the bridge to make the failure appear a perfectly normal and natural event. Much better pony-truss bridges have failed from the same cause, buckling of the upper chord. Most of the failures have gone unrecorded, but it may be stated as a safe estimate that in the last half-dozen years there have been at least ten or fifteen cases of just this kind; short-span steel pony-truss highway bridges, built with concrete floors and designed to carry traction engine loads, collapsing before they were opened to traffic.

Through plate-girder design, which is very extensively represented in the railroad bridge field, affords a thoroughly satisfactory model for the rigid and safe con-

*A small amount of gasoline is already obtained from the earth's stores of hydrocarbon in gaseous form or natural gas.

struction of low-truss highway bridges. Ample rigid bracketing to the transverse floor members at frequent intervals is known to be necessary in order to make the upper chord or flange secure against lateral buckling. Yet it is a fact that a great many low-truss highway bridges built for erection in remote country districts are almost devoid of bracketing or other stiffening of the top chord. In the present case, as may be seen from the sketch in the article already mentioned the only reliance lay in the slight stiffening effect of the vertical members of the truss web, assuming that these were rigidly riveted to the floorbeams. If, as the drawing suggests, the inner flange of each of these posts was cut in order to give room for riveting the floorbeams directly to the gusset-plate, practically all of this remaining stiffening effect was thrown away, and the top chord left virtually unstiffened from end to end. That these faults would coöperate with the common sin of building such trusses with unstiffened hip points (the upper chord at these points being interrupted and connected only by the thin flexible gusset-plate) can be realized at once.

After finding the design of the bridge thus fatally defective, one need not be further surprised to learn that the upper chord was so slight in section that even with its panel-points adequately stiffened it would probably have been too weak to carry more than its dead-load, without margin for carrying heavily loaded wagons.

It has before been noted that this type of bridge when built with concrete floor and a roadway surface of broken stone is greatly exposed to the danger of overloading by excessive thickness of the floor concrete and gradual accumulation of an excessive thickness of road metal. A little figuring will show that in any bridge of moderate span and intended for ordinary highway travel the weight of concrete and broken stone makes up a large part of the total load, and that a relatively small overrun in these two items may put considerable overstress into the members of the truss. As far as the concrete itself is concerned, a safe rule might be established requiring the supporting members of such a bridge to be designed for a 50% greater thickness of concrete than shown by the design. But even beyond this, provision must be made for probable future increase in thickness of the macadam surfacing, for road repair on country highways is not carried on by bridge engineers, and is often conducted on the plan of simply piling on more stone without regard to a set of long forgotten blueprints.

A Model for Engineering Conventions

The recent midwinter convention of the American Institute of Electrical Engineers, reported in our issue of a week ago, deserves study by other societies' officers for its unusually well organized program and immediate utility. This was helped perhaps by concentrating attention on a single aim—the discussion of discrepancies between recent attainments in the design of electric-power apparatus and the formal standards of testing and rating. This seemingly is a narrow field when so stated, but really is one which broadens and ramifies when more carefully considered. All engineers concerned in the recent production or purchase of electrical machinery in large units have run against this snag or that in the accepted ways of testing and rating this equipment, though, perhaps, unaware of others lurking. But everyone who attended these Institute sessions a couple of weeks ago must have carried away a comprehensive idea of advances in technical practice which the formal standards had not kept up with.

There were 44 formal papers on the program, but they were presented in related groups and discussed in groups. The practice at these sessions, of holding the authors to concise prepared abstracts of two or three paragraphs, is worth at least passing mention as a contrast with meetings (not necessarily of this society) where in the oral "abstracts," authors drag along for twice the time needed to read the whole paper. There was a snap and a dispatch to the business of this convention that speaks well for the parliamentary ability and tact of the presiding officers, and the intelligent application of the assembly.

The papers themselves disclosed the experience of manufacturing concerns in a way that once would have been feared as giving away the secrets of success. One important advance will probably be found to have been crystallized by this convention when, at some future date, we see the expected new standardization rules. Engineers, as purchasers of power machinery, have demanded that it should be tested before acceptance to demonstrate its ability to meet the conditions imposed. Manufacturers naturally have wanted to make such tests at their shops to assure themselves that changes were not going to be necessary after shipment and installation. While it is desirable in most instances to have acceptance tests made after installation and under the actual conditions of normal operation, yet occasions multiply when the conditions designed for cannot be developed without delay and excessive cost, or when the desired test cannot be made with sufficient accuracy without heavy expense for temporary equipment and staff. When machines were of comparatively small individual capacity actual full loads could easily be imposed at the factories; but with tremendous growth in sizes the power available at shops for driving has proved all too small—to say nothing about the excessive cost of true full-load tests, which after all, have to be paid for by the purchaser. So compromise tests are often desired by both parties—shop runs with full-load losses produced artificially in each part of a machine to permit the approximation of performance characteristics, heating, etc. We may now expect that the best of such tests for various types of motors, generators, converters, transformers, etc., will be standardized, eliminating the uncertainty with which they are regarded by some purchasers on one hand, and on the other hand preventing the delay and expense which worries the manufacturer.

An Old Object Lesson on Track Jacks Recalled

The extent to which both the reading pages and advertising pages of ENGINEERING NEWS are critically scanned by its readers, is illustrated by a letter received recently from a Division Engineer on a leading railway. We quote from the letter as follows:

I was rather surprised upon taking up the last "Engineering News" to see on one of the advertising pages a sketch showing a group of section men at work on a railway track

where one rail was jacked up with a track jack placed on the INSIDE of the rail.

As you, of course, remember, this practice was the cause of a very disastrous wreck on the Old Colony R.R., in eastern Massachusetts about 25 years ago, in which a number of lives were lost. I could not resist writing to you as I felt that a journal of the standing of "Engineering News" would not wish to use such an illustration even as an advertisement.

Our correspondent's letter serves a very useful purpose in calling attention anew to an important object lesson which received wide attention at the time of its occurrence, but of which many engineers of the younger generation have very likely never heard.

The accident referred to occurred Aug. 20, 1890, near Quincy, Mass., on the Old Colony R.R., now a part of the New York, New Haven & Hartford system. A fast express train came around a curve upon a party of section men who had not heard its approach because of the noise made by a passing gravel train on the other track. The men were engaged in tamping ties with a track jack under the rail placed on the inside of the rail.

As described in ENGINEERING NEWS of Aug. 30, 1890, the man in charge of the jack saw the train coming down on him and as the drop hook on the jack was not thrown forward to engage with the pawl, the man threw up the handle of the jack hurriedly in the endeavor to drop the jack. The drop hook failed to catch and the train was then too close to make a second attempt. The side of the locomotive pilot struck the jack, broke off its foot and tipped it over upon the rails directly in front of the advancing truck wheel. The locomotive went down the bank and one of the following cars slid over it and knocked off a projecting cock on the locomotive boiler. The contents of the boiler poured out through the hole, filling the car with scalding steam. The total casualties in the accident were 19 deaths and 27 persons injured.

We may add that a member of the present editorial staff of ENGINEERING NEWS not only recalls the accident but attended the investigation by the Massachusetts Railroad Commission.

The wide publicity given to this accident caused the general promulgation of a rule in railway track work that track jacks should be placed on the *outside* of the rail in all cases. It also led many railways to favor the use of jacks of a type which do not project above the top of the rail at all, and do not, therefore, endanger a train, should one come along suddenly before there was time to remove the jack.

It may be worth while, also, to note in calling attention to this accident of many years ago, that in an editorial upon it, written at the time of its occurrence, by the late Arthur M. Wellington, attention was called to a rule which should be in universal force on all double-track railways. Whenever an employee steps off from a track to get out of the way of an approaching train he should step to the outer side and not onto the other track. A very large proportion of the accidents to employees and others who are run down on railway tracks is due to men avoiding a train on one track and stepping in front of an approaching train on another track. At this time when the safety movement is attracting so much attention in railway circles, it is worth while to call attention to the wisdom of enforcing, so far as possible, this important rule.

The City Manager Plan

The city manager plan may become the next popular innovation in municipal government. It therefore seems desirable to review briefly its general progress, to show its relation to the old federal plan and also to the new and popular commission plan, as well as to discuss the city manager plan on its own merits.

The first city to adopt the city manager plan, so far as we know, was Staunton, Va. This small city, governed by a two-chambered council and a mayor, wishing greater municipal efficiency, appointed a general manager late in 1907, or early in 1908 (ENG. NEWS, July 8, 1909, pp. 32 and 42). The action was taken by the council and the mayor. Constitutionally the city was without power to adopt the commission plan, but whether or not it wished to do so we cannot state.

Several years later the Board of Trade of Lockport, N. Y., promoted a charter for third-class cities in New York State. The proposed charter provided for a small council and a city manager. The chairman of the council was to be known as mayor, and the charter would have had other commission plan features, but, unlike commission charters, the council here contemplated would have had few or no executive powers. (ENG. NEWS, March 16, 1911, col. 2, p. 333.) It is reported that a similar plan has been advocated for Dayton, Ohio.

Within the past two months, Sumter, S. C., a city governed by a small low-salaried commission, advertised for a city manager (see editorial comment, ENG. NEWS, Oct. 24, 1912, p. 783). We understand that the position was soon filled.

At the present time the city of Westmount, Que., a suburb of Montreal, is advertising for a "General Manager, who would give his entire time to the business management of the city."

Quite recently there have been introduced in the New Jersey legislature two bills (Assembly Nos. 402 and 403) which would make it possible for any commission plan city in that State to provide by popular vote for a city manager, to be appointed by the commission and to serve at its pleasure, but otherwise to exercise all the appointive and executive powers now vested in the commission governed cities. In commission cities which voted for a city manager the salaries of the commissioners would by that vote be reduced by 80%.

The city manager plan is much like the old "federal plan" of city administration, with its clear-cut separation of legislative and executive functions. Where the federal plan prevails in all its strength the adoption of the city manager plan would substitute a council-appointed manager for a popularly elected mayor as chief executive officer, either eliminating the mayor or stripping him of all or nearly all except his ornamental and social functions. But where commission government exists the grafting on of the city manager plan would have to be preceded by a violent wrenching away and separation of all executive powers from the council, except the single power of appointing a city manager. In other words, it would be a reversion to or adoption of the one distinguishing feature of the federal plan. There would be left, of course, to the commission plan cities such features as the initiative, the referendum and the recall, nomination and election reform, publicity in municipal affairs, and election of councilmen at large in-

stead of by wards, but any and all of these features are as readily incorporated in a federal plan charter as in a commission plan charter, although some of them may be more essential to the success of the commission than of the federal plan.

We have gone thus far into the effect of combining the city manager and commission plans not because we are opposed to city managers but in order to make it clear that such a combination is nothing more nor less than the abandonment of the basic feature of the commission plan. Tear away executive powers from a commission plan charter and vest them in a city manager and the result is a combination of the federal plan and the short ballot, with a city manager vested with the powers of the mayor. Having, as we trust, made this clear, a few words may be said regarding the merits of the city manager.

One of the greatest sources of weakness in our municipal government has been and still is the failure to select executive officers on the basis of fitness and fitness alone. A leading principle of the federal plan of city government was that the mayor, as chief executive officer, with sole power of appointing and removing all other executive officers, would not only have a free hand in selecting the executive staff of the city but, having a free hand, could also be held responsible for the personnel of the whole executive branch and thus to a large degree for the character of the work done by that branch.

If our mayors, like the nearest corresponding official in a German city, were themselves selected, on a competitive basis, for fitness to govern a city, and were retained in office during efficient service and good behavior, then a mayor under the federal plan might give efficient city government as a city manager. But at best our mayors are citizens above the average in business or professional ability and in moral character, while at their worst they go to the other extreme. In either case they are mere birds of political passage, coming into office with little or no experience as municipal executives and almost certain to be swept out of office by some political chance before much experience has been gained. While various election reforms and a general awakening of the electorate as to the importance of putting men of more capacity and sounder integrity in the mayor's chair may result in mayors of a higher average, the traditions and present tendencies of the mayoralty in the United States all indicate that during their usually brief terms our mayors will continue to be first, last and always the chief political representatives of the people—or of the political bosses, as the case may be—rather than being efficient, trained executive municipal heads.

The commission plan of city government reduces the mayor to the level of the other councilmen, so far as power and nearly everything else but title is concerned. Under the commission plan all executive as well as legislative power is vested in the commission and each commissioner heads a so called department, which oftentimes is, functionally, a combination of a number of departments into one. In some instances each commissioner has executive control of his own department and in others that control is exercised by the whole council. In no case is there a single executive head for the whole city, as under the federal plan. The theory, or at least the tacit assumption, is that by making each commissioner responsible for a so called department a layman citizen, through coming into office by the chances of popular election, in some mysterious manner becames qualified as an "expert."

Every engineer knows that neither "experts" nor any competent executive officers of any kind can be selected by popular vote. Failure to understand and be guided by this fact is one of the weakest points in the commission plan.

Another weak point in the commission plan is that while each commissioner is popularly supposed to be an "expert" and is supposed to devote a considerable part, if not all, of his time to the work of the city, the salaries paid are rarely commensurate with either supposition, much less with both of them. And yet the total of the five salaries is often a considerable item. There would be a distinct gain in paying the greater part of the sum total of these salaries to one real expert rather than to five imaginary ones.

From the foregoing considerations it seems to follow that the combination of the city manager and commission plans has much to commend it as a means of greater municipal efficiency, but it should be remembered that, as already explained, such a combination is virtually a return to the federal plan.

The adoption of the city manager plan in connection with a mayor and council possessed of more or less independent powers either confirms and strengthens the separation of functions under the federal plan, where that plan is in force, or virtually establishes that separation where it has never been adopted.

In any event, the city manager plan, if carried to its logical end, puts all the executive work of the city, including the making of appointments, the enforcement of laws and the execution of policies and works in general, in the hands of a single man, selected for fitness and retained in office during efficiency and good behavior. That this would be a great step in advance of present methods of municipal administration no one can successfully deny.

The success of the city manager plan, like the success of any other plan, depends upon the faithfulness with which it is carried out. To be successful, the manager must be selected for fitness only, must be retained in office during efficiency and good behavior, and must be absolutely free of all control by the city council or commission, except that inhering in the power of removal for cause. Anything short of this means weakness and probable failure in corresponding degree.

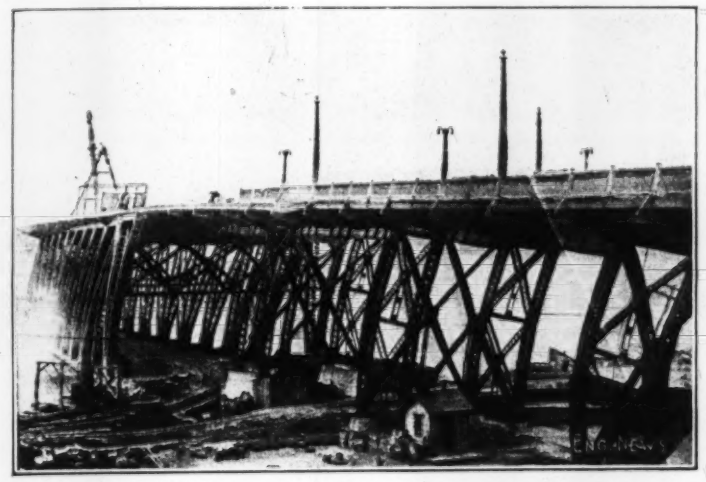
The city manager plan should appeal to engineers and to technically trained men generally, for besides improving the character of city government, where adopted and carried out in full, it would assuredly raise the status of the engineer and every other trained man in the municipal service. Engineers would often prove to be the successful candidates for city managerships and whether city managers were engineers or not the position of all engineers in the municipal service would be raised in dignity, merit would be more sure of having its due reward and the engineering work of the city would be on a higher plane.

It is highly desirable that the city manager plan be given full trial, under a wide variety of conditions. It will not prove to be a cure-all but it will help show the need and the value of employing and retaining competent trained men in the municipal and other branches of the public service.

LETTERS TO THE EDITOR

The Effect of a High Wind?

Sir—You may be interested in the accompanying somewhat unusual photograph. Perhaps you may find it possible to imagine a wind strong enough to cause the deformation in the structure as shown, which is the east end of the O. W. R.R. & N. Co. bridge over the Willamette River during construction! Personally, it is puzzling to



What a Photographer Can Do to a Bridge

see the calm security of the men seated by the watchhouse while such a terrific hurricane rages about them!

E. E. Howard.

Kansas City, Mo., Feb. 13, 1913.

[The distortion of the photograph in this view is so great as to be obvious, but it is readily conceivable that a similar distortion of less magnitude might confuse fact and fancy. The reliability of a photograph as evidence in court could be successfully attacked on the strength of this example.—Ed.]

Compound Rails on Chicago Street Railways

Sir—My attention has been called to statements contained in your issues of Nov. 28, 1912, and Jan. 23, 1913, in relation to the Romopac compound rail, and I ask you to correct some points upon which you have been misinformed.

A. No corrugation or cupping had appeared on the Romopac rail up to the date of my last visit on Nov. 26, 1912. No corrugation or cupping has developed on the Romopac rail laid in Leeds (England) in 1906. B. The inward bending of the flanges does not cause the head to bend slightly upward in any degree whatever. C. The heavier machine built in 1912 was constructed to utilize the power from the trolley wire and to insure greater speed. I inclose copy of report on the track laid in 1911, made to the Board of Supervising Engineers, Chicago. This report stands good as of Nov. 26, the date of my last visit, and as far as I know it stands good today.

E. Rhodes,

136 Third Ave.,
New Brighton, Staten Island, N. Y.

Feb. 6, 1913.

[Our statement as to the corrugation and grinding of the compound rail and its distortion during crimping was made on the strength of information by the engineering department of the Chicago City Ry. Co. From reports accompanying Mr. Rhodes' letter it appears that the grinding of the rails was to true up the joints, and that the rocking of the head section on the base section was due to failure of the mills to roll the rails true to the drawings. As to the corrugation, we have made inquiry of Mr. Fleming, Vice-President (and former Chief Engineer) of the railway company, for confirmation or correction of the former statement in our article, but he replies that the compound rail was laid as an experiment and he does not wish to make any statement for or against it until it has been given a good trial; and that it has not been in service long enough to enable conclusions to be reached. Mr. Rhodes and Mr. Del Mar (whose letter was published in our issue of Jan. 23) are engineers for the Continuous Rail Co., of New York, which is introducing the Romopac compound rail. The former sends us copies of reports made by him to the Board of Supervising Engineers (which has supervision over the Chicago street railways), and a report made to the rail company by Geo. Weston, Engineer of the Board of Supervising Engineers. As a matter of record and of interest in regard to the new type of rail, we give below (in condensed form) some of the matter contained in these reports:

From Report of Mr. Weston: Dec. 20, 1912. The contracts of the Continuous Rail Co., of New York, with the Chicago City Ry. Co. and Chicago Railways Co. covered the use of the Romopac compound rail for four miles of single track and were completed during the latter part of November, 1912. The total length of all track laid is 20,769 ft. of single track, all with granite block paving. The track laid in 1911 is on the west side of Halsted St., from 31st St. to 38th Place, 4401 ft.; the rails are on steel H-beam ties 4½ in. deep, 6 ft. 9 in. long, weighing 14½ lb. per ft. The base portion of the rail was electrically welded on the Lorain system, but no attempt was made to bond the head portion of this rail. The east track is laid with the standard Chicago 129-lb. grooved girder rail, with wood ties 2 ft. apart on a bed of rolled stone. The cars on this line weigh 54,000 lb. empty, or about 76,000 lb. with full load. The traffic is about 700 cars per day, on a headway of 15 to 40 sec. During the time the rails were being crimped, part of the track was open and exposed to variations of temperature amounting to 60° F., and there was at one time a fall of 61° in 24 hr. The winter of 1911-12 was severe, with a minimum temperature of 16° below zero; the maximum summer temperature was 95°. Inspection made in the spring of 1912 showed that the track was in good condition.

The track laid in 1912 was laid for double track on W. 16th St. and W. 47th St., equivalent to 10,957 ft. of single track. It has wood and steel ties at different parts. To increase the conductivity, an experiment was made by placing copper strips under the flanges of the head at the joints, and crimping the flanges over them. The specifications for the compound rail required 0.5 to 0.6% carbon, 0.6 to 0.9% manganese, and not over 0.04% phosphorus or 0.2% silicon. The

we ght was 83.3 lb. per yd. for the head portion and 74.3 lb. for the base section, a total of 157.6 lb. per yd. The specifications for the Chicago 129-lb. grooved girder rail require 0.6 to 0.7% carbon, but otherwise are the same as the above as to chemical compensation.

The steam machine for crimping the rail, which was brought from England, was not powerful enough for the rails supplied, which had flanges 0.48 to 0.486 in. thick (0.4832 in. average), while the drawing supplied to the mill showed a thickness of 0.4569 in. A more powerful electricaliy operated machine was built, and worked on the 1912 rails, whose flanges varied from 0.48 to 0.512 in. thick. This machine crimped 1972 ft. of rail in five working hours, and 5862 ft. in 27½ working hours during four days.

From Report of Mr. Rhodes; Sept. 30, 1912. The track laid (in 1911, on the west side of Halsted St.) is smooth running, and there is less noise from traffic than is usually the case. There are between 250 and 300 joints in the Continuous rail. When the rail was laid the work of filing or grinding these was begun, but was not completed before cars were run on the track. It is better to reduce the inequalities at the joints when the rails are first laid, and to use files worked by hand rather than to use a power grinder. The joints are in good order and the track seems to have been improved by the cold-rolling of the traffic during the last 10 months. The joints in the head section are difficult to detect at first sight, and this is particularly true of the rail nearest the curb, which bears the heavier weight owing to its being laid ¼ in. lower than the other rail.

In some of the first rails the head sections were found to be twisted, causing trouble in crimping them upon the base section. The flanges of the head sections also were thicker than they should have been and the radii of the curves of the fitting surfaces were not according to the drawings, so that in some cases the head section showed a tendency to rock on the base section, thus subjecting the flanges to stresses which should not exist. It has been arranged with the rolling mills to deliver the rails free of twist with flanges not varying more than 1/64 in. from the required thickness, and with correct radii of the contact surfaces. Investigation of the metal showed great homogeneity and closeness of grain, due to the method of rolling, and the weight of the metal averaged 10.47 lb. per 36 cu.in. as against 9.92 to 10.25 lb. for standard rails. These characteristics result in greater wearing qualities and greater conductivity. As to the latter point, tests show that it is 191.3% of the conductivity of the standard grooved girder rail in the adjacent track; taking the head section alone, the conductivity is 74.3% greater than in the grooved girder rail.

ED.]

Should Pipe Lines Be Carried under or over Streams?

Sir:—In an editorial in your issue of Feb. 20, 1913, under the title, "Cases Where Engineering Judgment Differs," you refer to a pipe line built in England, which was carried across the Trent River on a bridge having a clear span of 220 ft.

You say: "The puzzling question is why this line of conduits was carried over the stream on a bridge instead of laying the pipes beneath the river bed. The bridge was built especially for the pipe line, and carries nothing else save a footway."

You say further that an American engineer would have built this line under the river, rather than on a bridge.

Without knowing any of the details of this particular case, it is not possible to judge how an American engineer would solve the problem, but as a general proposition, I do not think it can be said the American engineers are particularly partial to crossings underneath rivers. In ENGINEERING NEWS of March 28, 1912, the writer described a pipe, and a bridge for carrying same across a river 500 feet wide. The decision to carry this pipe across the river on a bridge was reached after an expensive experience had with another pipe line previously carried *under* the bed of the same river. Not only was the first cost of this construction expensive because of troubles with water and excavations, but the pipe recently developed a leak which cost about $1300 to repair, and for a time it was feared that the flow of water would be cut off entirely, thus depriving 3000 acres of land of a much needed water supply for irrigation and resulting in a possible loss of many thousands of dollars. If the pipe had been on a bridge and exposed for inspection, this leak would never have been allowed to develop, or, had it developed, the cost of repairs would have been insignificant. Conditions being reasonably favorable, this seems to me sufficient argument for carrying a pipe across a river on a bridge and, in my opinion, it is generally a safer and more economical proposition.

Modern tendency is toward the construction of works so as to have all parts accessible for inspection and repair in case of accident, and placing a pipe on a bridge instead of carrying it under the river is only one example of this practice. It may be that the difference (granting that there is such) between American and English engineers in the case under consideration is not one of judgment, but one of progressiveness.

I heartily agree with you that "it is far more important to the engineer who reads engineering literature for its practical usefulness, to find out *why* a thing was done than *what* was done" and it seems to me that you editors are the ones to direct engineers along these lines (no doubt you do to some extent) and to suggest to prospective contributors at what points an article should be revised and amplified to make it of real value. Hundreds of descriptions of structures are published yearly, but many of them are not worth the time it takes to read them, because they do not contain ideas and methods which will be useful in future construction. They merely state *what* was done, not *why* it was done in a particular way.

E. A. MORITZ.

338 Maryland Ave., N. E.
Washington, D. C., Feb. 27, 1913.

[We may add that the pipe carried across a bridge and described in our issue of March 28 last was a 30-in. wood stave pipe forming part of an irrigation conduit. There were doubtless good reasons for preferring to carry the conduit over instead of under the river under the conditions described on that project. Where a steel or cast-iron conduit is to be laid and the conditions for placing it in the river bed are favorable, most engineers, we believe, will feel that the undercrossing is fully as reliable as the overcrossing.—ED.]

The Status of the Engineer

Sir—Having read the many and decided opinions expressed in your columns regarding the status of the practicing engineer, I wish to express some of the ideas that have come to me.

In my limited number of years in the field, I have been associated with graduates of the best technical schools in the United States, and some few from schools of Europe, also with men who have never finished a course in any school of engineering. It is needless here to draw a comparison. Suffice it to say, that if a comparison were drawn it would cause many a graduate of a high-grade institution to sit up and take notice.

Many so called engineers are such for the same reason that U. S. Grant became a cadet at West Point, namely, because his father said he should be. After they have gotten through school they lack the natural initiative to pull themselves out of the rut their mistaken but well meaning parents placed them in. They lack love for the work sufficient to crowd themselves to the top or even into a good responsible position. These seem to me to be the ones who are clamoring the loudest for legislative protection.

It has been my experience that good, reliable men in the engineering field have found due appreciation from their superiors and from the general public.

It seems to me unwise that legislative bodies should be called on to draw the line between trained and untrained men of any calling or profession. I am of the same opinion as the man who wrote that: "A race horse of true mettle cared not how many mules ran on the same track: it was only the would-be race horse, with his tail full of cockle burrs, who, when he felt the breath of the oncoming mule hot on his flank, would jump the track and say, 'I am down on mule equality.'"

Men who have enjoyed all the privileges of a liberal education, who are blessed with health and vigor, and endowed by nature with strength of character, good judgment and clear faculties, are in my humble opinion, in a weak position, when they ask to be protected from untrained men by state legislation, or other like processes.

Which of these engineers, who are in favor of a board of examiners, to deal out tin tags to applicants for a license to practice engineering, would willingly accept a position on such an examining board and then be directly responsible for all or any engineers who are granted a license? It is not always a question of whether a man is able to do a piece of work, but rather, whether he will do it.

It has been my experience that the very large majority of employers are entirely capable of judging between a good and a poor engineer. They do not ask him generally from what school he came, or how many degrees he took at college, or to how many and which engineering societies he belongs. But, rather, What have you done for the world in general? Who were your last two or three employers? In what capacity did you serve them, and why did you leave their employ?

The right to decide whether a man is capable of doing any piece of work, from shoveling dirt to the highest class of professional duties, belongs rightfully to the employer. That is where the question is decided now, so far as it concerns each and every employer, and always will be, no matter how many prefixes or suffixes you may attach to the engineer's name.

Do not understand that this is meant to cast a shadow on the credentials of any man. These have their place and are part of the essentials by which a professional man judges a professional man; but to the public they mean nothing now, and each year they are meaning less.

The argument for an engineering combine may be boiled down to this: that if an employer does not see fit to hire John Jones (a college graduate, and a member of two or three engineering societies, and holding a license from a State Board of examiners, and working at the union scale of wages) to run a line of levels for a drain ditch, that he may not hire Dick Smith, who has been doing this kind of work in an irrigation district for a number of years, and has given satisfaction, and does not care whether you call him an engineer or a surveyor or a levelman.

It would be as logical to say that if a man could not afford to carry a 21-jeweled Hamilton movement in a solid gold case, that he must not, under danger of prosecution, carry a one dollar watch.

Employers have the right to hire whom they please to do their work and there is no way of legislating this right away from them.

Let me illustrate my idea; suppose a man qualifies as an engineer by successfully passing an examination given under the supervision of a state board of examiners and is therefore entitled to write M. C. E. after his name. Suppose that another man fails to pass the same examination and he therefore writes X. Y. Z. after his name. They both live in the same district and through the operation of the law of supply and demand, X. Y. Z. is called on to perform certain duties, in the performance of which he clearly demonstrates that he is capable of doing this work as well at a lesser cost to the operators or owners than M. C. E., who has done a like piece of work. The employers in this district will quickly learn that X. Y. Z. means more to them than M. C. E., and unless a law is passed positively prohibiting X. Y. Z. from entering this field, he will slowly but surely crowd M. C. E. out of business.

M. C. E. is a very fine scholar and has passed a very good examination but he lacks the executive ability necessary to do big work and your examination has failed to show this lack, while X. Y. Z. may be lacking in technical knowledge but is especially gifted in executive ability and the examination has failed to give him due credit.

Let us stop trying to regulate everything and everybody by legislation! Let us cease to be governed by boards of examiners, investigating committees, and commissioners appointed by a politician, chosen from the ranks of politicians and ward healers, and live again as once we lived, when the foundation of our country was being laid, when it was a case of a man being judged by his deeds and not his titles, when a man's true worth placed him in a commanding position, and branded him as a leader. I say, give equal opportunity to all and may the best man win!

D. S. BURNETT.

Wausau, Wis., March 3, 1913.

NOTES AND QUERIES

Erratum. In the article on "The Oil Industry of California," in our issue of Feb. 6, reference was made to a report of the Commercial Club of San Francisco. This should have read the Commonwealth Club of San Francisco. Mr. Walcott, Executive Secretary of the club, calls our attention to the error.

A. J. Himes, Cleveland, Ohio, writes:

Apropos of your editorial in the current issue of "Engineering News," entitled "Cases Where Engineering Judgment Differs," I wish to refer you to a paper read before the Western Society of Engineers by A. A. Schenck on Dec. 17, 1902, entitled "Diversity of Practice in American Railway Engineering." This paper was published in the "Railway & Engineering Review," of Mar. 14, 1903.

I have kept a copy of this paper in my office for a number of years and refer to it occasionally, and advise young engineers, including my assistants, to read it. It is worth a great deal to know that there are other successful ways of doing work, besides your own.

The Army Engineers and Secretary Fisher on Hetch Hetchy and the San Francisco Water-Supply

Just before leaving office ex-Secretary of the Interior, Walter L. Fisher, issued a report which was designed to refer to Congress, but which may result in leaving to his successor in office, the long-standing controversy over the right of San Francisco to construct a dam and reservoir in the Hetch Hetchy Valley to store the headwaters of the Tuolumne River in the high Sierras. The report was dated March 1. On the previous Feb. 19 an Advisory Board of Army Engineers had submitted a report which was virtually an endorsement of the modified and enlarged Hetch Hetchy plan, as framed by John R. Freeman for San Francisco (see ENG. NEWS, Dec. 26, 1912). The Board concluded that the Hetch Hetchy supply would cost $20,000,000 less than any other feasible and adequate gravity supply, and $30,000,000 less than a filtered and pumped supply from the Sacramento River ($13,000,000 less if discounted to 1914, since the Sacramento supply could be built piecemeal). The Board also decided that in view of the inevitable, irresistible demand, sooner or later, for "all available water in the Valley of California" there is no valid reason for making San Francisco delay the Hetch Hetchy development until the Lake Eleanor and Cherry Creek sources have been utilized to their full capacities, as was required in the Garfield permit of 1908.

THE REPORT OF THE ADVISORY ARMY ENGINEERS

The Board was appointed in May, 1910, to advise Ex-Secretary Ballinger in connection with his order to show cause why the Garfield permit for rights in the Hetch Hetchy Valley should not be revoked. The Board consisted of Col. John Biddle, Lieut.-Col. Harry Taylor and Major Spencer Cosby. Congress granted it $12,000 for its investigations.

The Board secured the services of H. H. Wadsworth, assistant engineer, Engineer Department, U. S. A., to make personal examinations, estimates and a report on the questions at issue. Mr. Wadsworth's data and findings comprise a large part of the report which the Board submitted on Feb. 19.

It may be explained further that ex-Secretary Fisher inherited ex-Secretary Ballinger's order to show cause why the portion of the permit covering Hetch Hetchy should not be revoked, and that he granted to San Francisco a number of extensions of time to answer the Ballinger order. Some of these extensions, however, were due to the great detail which Mr. Fisher required San Francisco to go into in support of its application for an enlarged permit to enable it to build at once a higher dam in the Hetch Hetchy Valley than was originally proposed. It should also be stated that since San Francisco first proposed to utilize Hetch Hetchy a plan has been devised for a metropolitan or bay cities water-district.

The report of the Board and particularly Mr. Wadsworth's much more detailed report, compares the estimated costs of the various sources of water-supply which it considers available to San Francisco and its neighbors. Although considering Mr. Freeman's Tuolumne or Hetch Hetchy unit costs as too low the Board, nevertheless, uses these in its various estimates, since they will serve for comparative purposes. It also assumes that the proposed works would be built in installments, beginning with 100,000,000 gal. daily capacity available in 1920 and continuing until 400,000,000 gal. capacity had been provided by the year 2000—all the capacities being additional to the existing water-supply, we understand. Dealing only with the full supply of 400,000,000 gal., the comparative costs assumed by the Board are as follows

	Cost	Present (1914) value*
Hetch Hetchy, including Lake Eleanor	$77,367,400	$38,900,000
Eleanor, Cherry, Stanislaus, Mokelumne†	99,246,800	57,700,000
American, Cosumnes, Stanislaus, Mokelumne	96,711,700	55,300,000
McCloud, via Bay Crossing	.....	57,750,000
McCloud, via Dumbarton Point	.....	63,910,000
Sacramento Filtered Supply, via Bay Crossing	107,012,200	51,700,000
Sacramento Filtered Supply, via Dumbarton Point	118,953,000	57,000,000

* Value of amounts required for financing projects, 4½% compound interest.
† This is really the Tuolumne River supply, minus the Hetch Hetchy storage, plus two other river supplies to make good the loss of Hetch Hetchy.—Ed.

Water-power development possibilities in connection with the first three of these schemes, capitalized at 4½%, and not included in the foregoing cost estimates, are given by the Board as follows:

	Horsepower	Value
Hetch Hetchy	115,000	$45,000,000
Eleanor, Cherry, etc.	95,000	37,250,000
Stanislaus-Mokelumne, etc.	62,000	24,300,000

The conclusions of the Board are as follows:

The board is of the opinion that there are several sources of water-supply that could be obtained and used by the city of San Francisco and adjacent communities to supplement the nearby supplies as the necessity develops. From any one of these sources the water is sufficient in quantity and is, or can be made, suitable in quality, while the engineering difficulties are not insurmountable. The determining factor is principally one of cost; in some cases, however, such as the Sacramento, sentiment must be taken into consideration.

The project proposed by the city of San Francisco, known as the Hetch Hetchy project, is about $20,000,000 cheaper than any other feasible project for furnishing an adequate supply. The only exception is the filtered Sacramento project, which in actual cost is about thirty millions greater than the Hetch Hetchy project, but by discounting to 1914 becomes only $13,000,000 greater.

The Hetch Hetchy project has the additional advantage of permitting the development of a greater amount of water-power than any other.

The best available sources, outside of the Tuolumne River, appear to be the filtered Sacramento, the McCloud, a combination of the Lake Eleanor-Cherry-Stanislaus and Mokelumne, and a combination of the American-Cosumnes-Stanislaus and Mokelumne. For a smaller supply the Eel River or the Yuba River could be used, but they do not lend themselves economically to combination with other sources, and are therefore to that extent not available.

From the statement of John R. Freeman, in the hearing beginning Nov. 25, before the Secretary of the Interior, it appears that the city, in case of being denied the Hetch Hetchy, will desire to use the Lake Eleanor-Cherry-Stanislaus-Mokelumne combination. In the report of Mr. Freeman of Jan. 30, 1913, the cost of this project is largely in excess of either the McCloud or the Sacramento River projects.

The board is of the opinion that the use of the Hetch Hetchy Valley as a reservoir site is necessary if the full flow of the upper Tuolumne is to be conserved.

The board further believes that there will be sufficient water if adequately stored and economically used to supply both the reasonable demand of the bay communities and the reasonable needs of the Turlock-Modesto Irrigation District for the remainder of this century.

The Valley of the San Joaquin has less rainfall and less run-off from its river than the Valley of the Sacramento. The Tuolumne River could, if not used for city supply, be used to irrigate a large amount of fertile land, as could almost any river in the Valley of California if means are found economically to store the water.

The board believes that on account of the fertility of the lands under irrigation and their aridness without water the necessity of preserving all available water in the Valley of California will sooner or later make the demand for the use of Hetch Hetchy as a reservoir practically irresistible. The

board does not think that a delay of a few years in transforming the Hetch Hetchy Valley into a reservoir is of importance, and therefore does not think it necessary to require delaying construction of this reservoir until the Lake Eleanor and Cherry sources have been fully developed.

The board believes that the regulations proposed by the city will be found sufficient to protect the waters from pollution, and that these regulations will tend toward the protection of campers and others using the park and will not be onerous upon them. It recommends, however, that the permit to the city require the city to take other means, such as filtration, to purify its water-supply if these regulations are ever deemed insufficient.

The construction of reservoirs, especially the Hetch Hetchy, will destroy a few camping grounds in the park. The construction of the proposed trails will, however, render accessible other parts of the park not now readily reached, and the number of camping places within the park is large.

The water situation that will confront the communities around San Francisco Bay, if the plan proposed by the city of San Francisco is adopted, may be recapitulated as follows:

Purchase of Spring Valley Water Co., $35,000,000 to $40,000,000.

Further development of this company's system to about half the extent proposed by the company, $10,000,000.

Purchase of water systems of communities outside of San Francisco, no estimate made.

Construction of Tuolumne system as proposed by city of San Francisco, to be extended over about 50 years, $77,000,000.

Against the above expenditures there will be developed 115,000 hp., having an estimated capitalized net value of $45,000,000.

Finally, the board wishes again to emphasize the fact that it does not present the various estimates given as reliable estimates of the cost of the different projects. Sufficient data are lacking as well as time and funds for making adequate investigations. The board believes, however, that the estimates are sufficient to permit such comparisons as are necessary to be made for judging the relative cost and merits of the different projects.

The latest form of the modified permit desired by San Francisco contained the following very brief and simple sanitary requirements, which follow suggestions made by Allen Hazen and George C. Whipple:

(1) No human excrement, garbage, or other refuse shall be placed in the waters of any reservoir or stream, or within 50 ft. thereof.

(2) All sewage from permanent camps and hotels within the watershed shall be filtered by natural percolation through porous earth, or otherwise adequately purified.

(3) It is forbidden to bathe, wash clothes or cooking utensils, to water stock, or in any other way pollute the waters within the limits of the Hetch Hetchy Reservoir or any reservoirs so consructed by the city, or in the streams leading thereto, within 1 mile of said reservoirs; or, with reference to the Hetch Hetchy Reservoir, in the water from the reservoir or waters entering the river between it and the "Early intake" of the aqueduct (as indicated in the report of John R. Freeman, on file in these proceedings), pending the completion of the aqueduct between "Early Intake" and the Hetch Hetchy Dam site.

The Board advised that there be added to these requirements the following:

The cost of the inspection necessary to secure compliance with these rules under the direction of the Secretary of the Interior shall be defrayed by the city of San Francisco and other cities. If at any time the rules are deemed by the cities insufficient to protect the purity of the water-supply, then the cities shall install a filtration plant or adopt other measures to guard the purity of the water. No other sanitary rules or restrictions shall ever be demanded by the cities as to the use of the watershed by campers, tourists, hotels, cottages, etc.

The Fisher Report

Ex-Secretary Fisher's communication to the city officials of San Francisco, dated Mar. 1, 1913, first reviews a portion of the history of the Hetch Hetchy controversy. It shows that the Yosemite National Park was created, not as a National park but as a forest reservation, by an Act of Congress in 1890. This act placed the reservation under the control of the Secretary of the Interior, directed him to make regulations for its care, and stipulated that those regulations should "provide for the preservation * * * of all natural curiosities or wonders, within said reservation, and their retention in their natural condition."

In 1901 Congress passed an act authorizing the Secretary of the Interior to grant rights of way through public lands, forests and certain national parks, including the Yosemite, for pole and wire lines, pipe lines, dams, etc., for electrical, irrigation and domestic water-supply purposes. The act provided that any such rights might be revoked by the Secretary of the Interior.

Under the act of 1901 the city of San Francisco, in the same year, made its first application for reservoir rights at Hetch Hetchy and Lake Eleanor. E. A. Hitchcock, then Secretary of the Interior, decided in 1903 and again in 1905 that he lacked statutory authority to grant these rights, and that such authority must be secured from Congress. In 1908, James R. Garfield, successor to Mr. Hitchcock, granted a permit, despite strong opposition from those who claimed that to flood Hetch Hetchy would be a desecration of nature; but the Garfield permit required the city to postpone the construction of the Hetchy dam until other reservoir sites on upper Tuolumne had been utilized and become insufficient. The Ballinger order to show cause why the Garfield permit, so far as it applied to Hetch Hetchy, should not be revoked, has already been mentioned, as has Secretary Fisher's inheriting of that order and subsequent proceedings (see also Eng. News, Dec. 26, 1912, for further details).

In brief, Mr. Fisher decided that while he had statutory authority (thus disagreeing with Mr. Hitchcock and agreeing with Mr. Garfield) to grant the modified and enlarged permit, such a grant, as a matter of public policy, should be exercised by Congress and not by an administrative officer, since (1) a reservoir in the Hetch Hetchy Valley would materially change one of the "wonders" which the Yosemite National Park is supposed to preserve and (2) since the only control over pipe lines, dams, etc., given the Secretary of the Interior by the act of 1901 is through a "revocable permit," which is an anomalous condition in the case of any right-of-way and particularly so where the right is for a huge reservoir and aqueduct for the water-supply of a large urban district. Furthermore, Mr. Fisher found himself, due to the many postponements in supplying him with data, wholly without time to draft a permit to his satisfaction, even had be been willing to issue a permit in this case. Consequently he took no action on either the Ballinger order to show cause why the Hetch Hetchy portion of the Garfield permit should not be revoked nor on the application for an unlimited Hetch Hetchy permit be granted but left both in *statu quo* until the city could apply to Congress for an enabling act.

Mr. Fisher was particularly careful not to pass upon the merits of the question. On the one hand he did not feel warranted in accepting as the "principal determining factor" in the case "the difference in cost between available alternative sources of water-supply, whether that difference be $13,000,000 or $20,000,000, or even more than $20,000,000," for to do so "would, in a certain important sense, be placing a monetary value

upon the preservation of the Hetch Hetchy Valley in its present natural condition" and would be calling upon "the people of the whole country to change the natural condition of the Hetch Hetchy Valley" to save the people of San Francisco "a certain sum of money." On the other hand: "It may well be that such consent would be justified. It depends upon the effect of the use permitted, and upon the amount saved, as well as upon other considerations." Furthermore:

> This conclusion is not based upon the opinion that the conversion of the Hetch Hetchy Valley into a reservoir or lake would so seriously mar the scenic beauty of the valley as is contended by many of the objectors to the city's application.
>
> I have been convinced that the proposed use of the Hetch Hetchy as a reservoir will not require undesirable sanitary restrictions upon the use of its watershed by the public, if the permit contains the provisions recommended by the Advisory Board.
>
> If the use of the Hetch Hetchy Valley was clearly necessary for the city of San Francisco and its adjacent communities, I believe that such a change in its condition and such a loss or impairment of scenic beauty as might possibly occur would be amply justified and would not be a matter of such serious moment as to be at all controlling. It is indeed an open question about which real differences of disinterested and intelligent opinion exist whether the valley would not be as beautiful if it contained the lake created by the dam as it is with its present natural floor. Nevertheless, the valley should be retained in its natural condition unless ample justification exists for changing it. . . . . This provision [for preserving park "wonders" in "their natural condition"] should be followed unless there is clearly some adequate justification for a different course.

Towards the close of his report Mr. Fisher says he prefers to express no opinion upon what action Congress ought to take in this case. This is partly due to what he considers to be a lack of information and a need of further consideration regarding two of the conclusions reached by his Advisory Board: (1) that "the use of the Hetch Hetchy Valley as a reservoir site is necessary if the full flow of the upper Tuolumne River is conserved"; and (2) that "the San Joaquin Valley is relatively less well provided with water than the Sacramento Valley both as to rainfall and as to runoff of rivers. The demands of the valley for complete irrigation are in excess of the water available."

Finally, Mr. Fisher believes with the Advisory Board that it would be unsound economics for San Francisco to duplicate the distributing system of the Spring Valley Water Co. and that the city should acquire nearly, if not all, the company's sources of supply. In fixing a price for these properties Mr. Fisher urges equal justice to the city and the company. Referring to unsuccessful purchase negotiations he declares that if the city and company cannot agree on the price "both parties should be compelled to submit to some impartial tribunal the questions at issue."

FIGS. 1-3. WRECK OF PARTLY-BUILT LOW-TRUSS HIGHWAY BRIDGE OVER ARKANSAS RIVER AT WELLSVILLE, COLO., BY BUCKLING OF UNSTAYED UPPER CHORDS

Failure of a Steel-truss Highway Bridge in Colorado

BY W. H. HUBBARD, JR.*

On Feb. 4, 1913, a steel highway bridge which was being built across the Arkansas River, near Wellsville, approximately 6 mi. east of Salida, Colo., failed to support its own weight, and fell into the river. Figs. 1 to 3 illustrate the wreck.

The bridge had a span of 85 ft. and a width of 15 ft. 7 in. in the clear, and was being built to take the place of an old wooden structure (seen in the background of two of the views). The main members were steel riveted trusses of the low-truss Warren type. The floor was to have been of reinforced-concrete slab on steel I-beam stringers.

At the time of the failure, the steelwork had been completed and the falsework removed. The concrete floor was being laid, beginning at one end of the bridge and proceeding to the other end; a little more than half of it was in place.

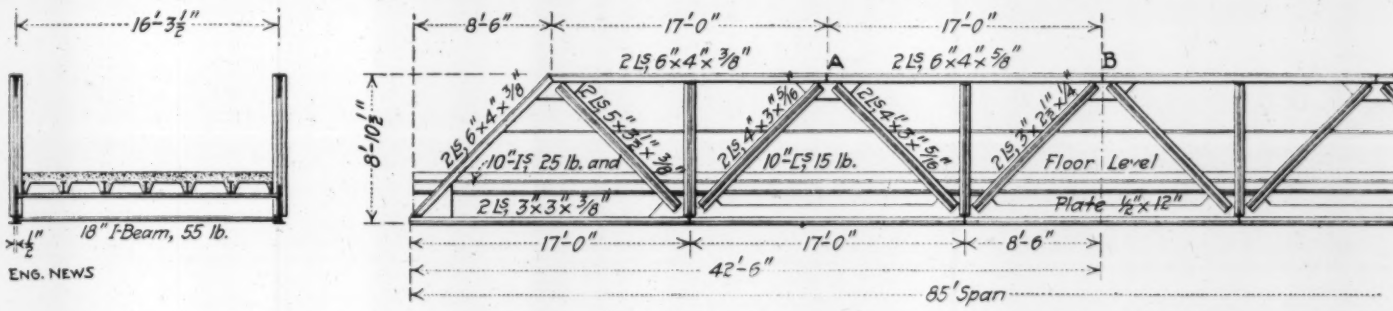
The writer inspected the wreck shortly after the failure and trusts that this brief information on the subject may be of interest to the profession.

It was found that all principal riveted connections were intact. A few minor rivets were sheared, but this evidently was the result rather than the cause of the failure. The same may be said of the slight damage to one of the concrete abutments. Investigation points to the fact that the failure was due to improper distribution of the steel in the structure; primarily, lack of sufficient lateral stiffness in the upper chords of the trusses.

*Engineer for the Ohio & Colorado Smelting & Refining Co., Salida, Colo.

The sketch Fig. 4 shows the general design of the structure, together with a stress diagram for estimated dead-load. Study of the design suggests that in length of span this bridge crowds the limit set by best practice for riveted low-truss bridges. If, however, such a truss was to be used for this span, the T-shaped section of the upper chord is objectionable. The use of this section is particularly open to criticism in view of the fact that no bracing whatever was provided for the upper chord. The resulting lack of rigidity of the upper chord seems to be a sufficient reason for the collapse of the bridge.

It will be noted that the floorbeams were attached by lug angles to the web-plate connections at the panel-points, and above the lower chords. This connection tended to produce eccentric loading of the trusses, which would create further need for upper-chord bracing. There is certainly not enough stiffness represented in the verticals at the loaded panel-points to warrant the absence of any diagonal braces.



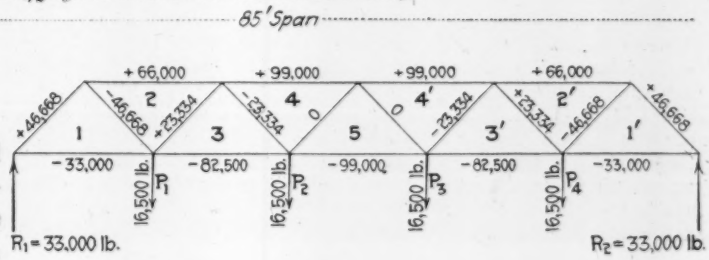


FIG. 4. DESIGN SKETCH AND DEAD-LOAD STRESS DIAGRAM, ARKANSAS RIVER BRIDGE AT WELLSVILLE, COLO.

The writer made no effort to ascertain the live-load which this bridge was expected to carry, since the failure occurred before any such was brought upon it. The dead-load, figured from estimated weights of main members and concrete only, amounts to approximately 16,500 lb. at each lower panel-point. The direct stress in the middle bays of the upper chord by these loads would be 99,000 lb. The cross-section of the member which must resist this stress consists of two 6x4x⅝ in. angles set ½ in. back to back, which gives a radius of gyration of 1.71 in. and a sectional area of 11.72 sq. in. The length of the strut is 119 radii.

J. A. L. Waddell specifies the formula for unit-stress in upper chords of $18{,}000 - 80\,\frac{l}{r}$, which would allow on such a chord a total stress of 99,385 lb. Prof. M. S. Ketchum's specifications call for a unit-stress of $16{,}000 - 70\,\frac{l}{r}$ which would safely allow a stress on the above chord of 89,892 lb. In the absence of upper-chord bracing, and the consequent uncertainty as to strut-length in the upper chord, of course the above figuring does not represent a true condition. It merely serves to show the condition which proper bracing would have brought about, and to illustrate how little in reserve this strut had for live-load.

While such failures are a misfortune, the citizens of the district may congratulate themselves that the impact of a rapidly moving touring car or the weight of a traction engine was not needed to point out the weakness of this so called design.

Information to Passengers as to cause of delays is to be freely given on the Pennsylvania R.R. hereafter, according to recent instructions which have been issued to all conductors of passenger trains. This order states that when traffic is interrupted trainmen shall go immediately through their trains and tell passengers the reason for the delay, and if necessary the best means of proceeding on their journey. Instructions have been given to station agents to post on their bulletin boards, or in other conspicuous places, notices giving the location of whatever obstruction to traffic is taking place, the probable length of delay, and any other information in their possession.

Lower Street-car Steps in New York City have been ordered by the Public Service Commission for the First District, State of New York, and it is directed that all closed cars shall be reconstructed on or before Jan. 1, 1914, with steps whose maximum height is 15 in. The New York & Queens County R.R. Co., the New York & Long Island Traction Co., and the Queens County Electric Co. (operating on Long Island), however, are allowed to delay the equipment of one-half their cars until Jan. 1, 1915. Complaints of excessive height of step were made some two years ago by various woman clubs, and the commission on investigation found that the first step varied from 12 to 20 in. The use of folding steps was investigated in New York and other cities, and it was reported that they were feasible and popular.

A Public Utilities Commission for the District of Columbia was provided by an act of the Congress which adjourned on Mar. 4, 1913. For the past few years the street railways within the District have been under the general supervision of the Interstate Commerce Commission (assisted by a non-salaried Electric Railway Commission), but this Commission has been so burdened with its regular work that the attention paid the District's railways has been quite small. The new Public Utilities Commission has a broader range than was provided for the Interstate Commerce Commission in the previous act. According to the act, the term public utility embraces every street railroad, street railroad corporation, common carrier, gas plant, gas corporation, electric plant, electrical corporation, water power company, telephone corporation, telephone line, telegraph corporation, telegraph line, and pipe line company. The commission is to have the power generally accorded to public service commissions, and is particularly ordered to make a valuation of all the public utilities in the District of Columbia. The commission is to consist of the three Commissioners of the District of Columbia, acting ex officio as members of the Public Utilities Commission and acting apparently without additional salary. It is to have as its counsel the Corporation Counsel of the District of Columbia, who is to receive an additional annual salary of $1000 for this service. An appropriation of $40,000 is granted the commission for its first year's work.

The Hamburg-American Liner "Europa," sister ship of the "Imperator," is to be launched on Apr. 3, according to recent press dispatches. The "Europa" is 950 ft. long and has a beam of 100 ft.

A Fire in the Business District of Yokohama, Japan, on Mar. 6, consumed about 4,700 buildings and caused an estimated loss of $7,500,000.

A Runaway Locomotive on the Philadelphia & Reading Ry. crashed through the wall of the new roundhouse at St. Clair, Penn., and down an embankment, on Mar. 2.

The German Torpedo Boat "S-178" Was Rammed by the cruiser "Yorck" off Heligoland, on the night of Mar. 4, and sank immediately, with two officers and 69 of the crew, 13 being rescued. The fleet of war vessels was returning from naval manoeuvers and the accident occurred when the torpedo boat became unmanageable while crossing the bows of the larger ship, which was traveling at full speed. From newspaper reports it appears that it has been customary for the small high-speed craft to cross between larger boats, traveling at full speed, a practice which would obviously invite disaster.

Two Trestle Failures, involving freight wrecks, were recorded during the past fortnight. At Athens, Ga., on Mar. 5, the last four cars of a 22-car freight on the Central of Georgia Ry., fell through a trestle to the bed of a creek, 45 ft. below. It is believed that one of these cars became derailed on the trestle and tore through, carrying the others along with it. The front part of the train passed over the trestle safely.

At Richmond, Ind., on Mar. 4, a trestle failed under a heavy freight and the entire train fell through to the ground. As in the previous case, it is believed that a derailment tore the trestle timbering apart and allowed the cars to fall. This accident occurred on a branch of the Chesapeake & Ohio R.R.

Blame for the Wreck of Feb. 16, at the Cedar Hill yards, New Haven, Conn., was placed on the New York, New Haven & Hartford R.R., in the report of the Connecticut Public Utilities Commission. The charges made were that the trackage at the place where the collision occurred was insufficient to accommodate the traffic, that the signal apparatus was inadequate, and that the speed of the passenger train was excessive in view of the weather conditions and the known dangers of that section. Suggestions for increasing safety were made to the railroad, including improvement of the signal system.

Three Hundred Tons of Dynamite Exploded in the hold of the British tramp steamer "Alum Chine," on Mar. 7, while she was being loaded in the harbor at Baltimore, Md. It is estimated that about 50 were killed and 60 injured in the explosion. The "Alum Chine" was totally demolished, together with a barge lying alongside and also loaded with dynamite. The United States collier "Mason," a short distance from the scene of the accident, was set on fire and badly damaged and the tug "Atlantic," which was rescuing the crew of the tramp steamer, was wrecked and sank shortly after the explosion.

Fire was discovered in the hold of the "Alum Chine" before the explosion and was the signal for the crew's escape. The cause of the fire is not known, but it is believed that it resulted finally in setting off the dynamite. It is claimed by some of the survivors that the explosion was caused by the negligence of one of the stevedores in handling a box containing either dynamite or exploding caps. The property damage is placed at $500,000. According to newspaper reports the shock of the explosion was felt at points over 100 miles from its scene. The steamer was a steel vessel, and parts of the hull and superstructure are said to have been found along the shore, three and four miles away. The dynamite was destined for use at the Panama Canal.

More Water for Power Purposes may be taken from the Niagara River, because of the failure of Congress to re-enact the Barton Law, which for several years has limited the amount of water available for this use to 16,600 cu.ft. per sec.

Bonds Totaling $12,500,000 for Water and Power Distribution from the Los Angeles Aqueduct are to be voted on at Los Angeles, Calif., on Feb. 15. Of this total, $6,000,000 is for water distribution (see "Surplus Waters of the Los Angeles Aqueduct," pp. 506-510 of this issue), divided as follows: Chatsworth Line, $1,500,000; Franklin Cañon Line, $1,500,000; to start Graham High Line, $2,500,000.

One of the Longest Railway Tunnels in North America is to be built for the Canadian Pacific Ry. The tunnel is located in the Canadian Rockies near Rogers Pass. It will have a total length of about 28,000 ft. Its purpose is to lower the summit level and improve the grades and alignment of the Rogers Pass division. Bids for its construction are to be opened at Winnipeg on April 15.

The Proposed Subway under St. Paul's Cathedral, in London, was withdrawn by the London County Council on Feb. 25. As noted recently in "Engineering News," a report by Sir Francis Fox, the eminent English engineer, stated that such a subway would be extremely dangerous to the stability of the Cathedral.

A Workman's Compensation Act was put in force for government employees in the Canal Zone on Mar. 1. Under the terms of this act, an employee totally disabled from work by an accident will receive a monthly compensation equal to half of his monthly pay. For accidents causing partial disability, the employee will receive compensation equal to half the difference between his former monthly pay and his wage earning capacity per month when partially disabled. In case of accidental death the surviving widow receives 35% of her husband's monthly wages for the first six-year period. After that time until the death or the marriage of the dependent occurs, between 20 and 30% is paid. Ten per cent. additional is paid for each dependent child, the total compensation, however, not exceeding 50% of the wages.

A New Park in the District of Columbia is provided by an act of the recent Congress. This park is to connect the present Rock Creek Park in the northwest section of the city with the Potomac Park in the southeast portion of the city and bordering on the Potomac River. It will thus make a park system in the District, which will girdle the city for practically half of its circumference. The total sum authorized to be expended in the purchase of this park is not to exceed $2,300,000. It is provided in the act that the U. S. Botanic Garden, which is now located just west of the United States Capitol, is to be transferred to this new park when it is completed.

The Loetschberg Ry. in Switzerland was completed on Feb. 28 by the laying of the last rail. This is the new line from the Bernese Oberland to the Rhone Valley through the great Loetschberg Tunnel. This new line gives a direct route from Berne, the capital of Switzerland, south to Italy through the Simplon Tunnel, and is expected to cause a considerable increase in traffic over the Simplon route. Work on the driving of a second parallel tunnel to the Simplon has already been under way several months. The contractor for the first tunnel was obligated to do the work, but declined, and has now settled with the government, which is carrying it out.

A Storage-battery Car, designed by R. H. Beach, of the Federal Storage Battery Co., of Silver Lake, N. J., and equipped with Edison nickel-iron cells, made a trial trip over the New York Central Lines from New York City to Boston on March 7. The run of 310 miles was made at a running speed of 40 miles per hour. The equipment is claimed to have a distance capacity of 120 miles per charge. It is reported that if this car proves suitable in trial service, similar ones will be used on a number of feeder lines where the density of traffic does not warrant a frequent steam service.

The Wright Brothers' Patents on flying machines have been sustained by Judge J. P. Hazel, in the U. S. District Court, at Buffalo, N. Y. This suit was brought against Glenn H. Curtiss and others to restrain them from making and selling aëroplanes alleged to infringe the Wrights' patents. The chief infringement claimed was in the matter of warping wing tips in connection with the vertical and horizontal rudders. The court held that the Curtiss "ailerons," or auxiliary wing-tip planes, operated to restore equilibrium and were a mechanical equivalent of the Wrights' invention. The defendants contended that the Wright devices were but adaptions of earlier schemes, but the court dismissed that consideration, stating that it had not been shown that any of the earlier devices were capable of successful operation, nor that their defects could have been removed by mere mechanical skill. The court was of the opinion that the Wrights "by their methods of securing equilibrium of the planes have made an important advance in an embryonic art."

Cable dispatches from Leipzig, Germany, state that the decision of the German Patent Office, made a year ago and adverse to the Wright claims, has been in part set aside by the Imperial Supreme Court.

PERSONALS

Mr. William N. Ashplant has been appointed City Engineer of London, Ont.

Mr. Caleb Corser has ben appointed Superintendent of the Copper River & Northwestern Ry., with headquarters at Cordova, Alaska, succeeding Mr. George Geiger, resigned.

Mr. V. K. Hendricks, M. Am. Soc. C. E., Principal Assistant Engineer of the St. Louis & San Francisco R.R., at Springfield, Mo., has been promoted to be Assistant Chief Engineer.

Mr. J. E. Gardner has been appointed Electrical Engineer of the Chicago, Burlington & Quincy R.R., with headquarters at Chicago, Ill., succeeding Mr. H. A. Gardiner, resigned.

Mr. N. W. Jones, Trainmaster of the Philadelphia & Reading Ry., at Tamaqua, Penn., has been promoted to be Inspector of Transportation, with headquarters at Reading, Penn.

Mr. Wilbur C. Fisk, Vice-President of the Hudson & Manhattan R.R., New York City, has been elected President, to succeed Mr. William G. McAdoo, resigned.

Mr. E. E. Finley has been appointed Superintendent of Maintenance-of-Way of the San Antonio & Aransas Pass Ry., with office at Yoakum, Tex., succeeding Mr. Hans Helland, resigned.

Mr. John H. Harris, formerly with the Chicago, Rock Island & Pacific Ry., has been appointed General Manager of the Peoria Railway Terminal Co., Peoria, Ill., succeeding Mr. J. H. Franke.

Mr. John H. Marble, recently Secretary of the Interstate Commerce Commission, has been appointed a member of the commission. Mr. Marble is a lawyer and was formerly in practice in California.

Mr. F. W. Hawks, who went to China in 1909 with Mr. W. S. Dawley, M. Am. Soc. C. E., as Assistant Chief Engineer of the Yunnan-Szechuan & Tengyueh Ry., has returned to this country, and is now in Galesburg, Mich.

Mr. E. N. Brown, formerly Assistant Superintendent of the Southern Pacific R.R. of Mexico, has been appointed Superintendent of the Chicago & Eastern Illinois R.R., at Danville, Ill., succeeding Mr. John C. Muir, resigned.

Mr. Henry R. Kent, M. Am. Soc. M. E., has resigned as Vice-President of Westinghouse, Church, Kerr & Co., to enter business for himself. Mr. Kent has been associated with the company since its organization over 28 years ago.

Mr. C. A. Dunham, recently appointed Signal Engineer of the Grand Trunk Ry., at Montreal, Que., has resigned to accept his former position as Signal Engineer of the Great Northern Ry., at St. Paul, Minn.

Mr. I. W. Patterson, Jun. Am. Soc. C. E., formerly Highway Construction Engineer for the Texas Co., has been appointed Chief Engineer of the Rhode Island State Board of Public Roads, at Providence, R. I.

Mr. John Hoffhine, formerly Assistant Chemist, Union Pacific R.R., Omaha, Neb., has been appointed Chemist of the American Brake Shoe & Foundry Co., New York City. Mr. Hoffhine is a graduate of the Ohio State University, class of 1904.

Mr. Charles V. Seastone, Assoc. M. Am. Soc. C. E., formerly Principal Assistant Engineer for Prof. Daniel W. Mead, M. Am. Soc. C. E., Consulting Engineer, Madison, Wis., has been taken into partnership with Prof. Mead in his engineering practice.

Mr. W. C. Perkins, Assoc. M. Am. Soc. C. E., Resident Engineer of the New York State Highway Department, Niagara Falls, N. Y., has been appointed Chief Engineer of the inspection department of the Dunn Wire-Cut Lug Brick Co., Conneaut, Ohio.

Mr. George Ross, recently Assistant Superintendent of the Oregon Short Line R.R., at Salt Lake City, Utah, has been appointed Assistant Superintendent of the Oregon-Washington R.R. & Navigation Co., at La Grande, Ore., succeeding Mr. J. W. Anderson, resigned.

Mr. E. S. Carman has been appointed Chief Engineer in charge of design and construction of the molding machine department of the Osborn Manufacturing Co., Cleveland, Ohio. For the past 10 years Mr. Carman has been associated with the Johnson & Jennings Co., of Cleveland.

Mr. George N. Adams, for the past three years Resident Engineer of the Arrowhead Reservoir & Power Co. project in San Bernardino County, Calif., has formed a partnership with Mr. L. L. Shears, of Los Angeles, Calif., as civil and hydraulic engineers, with offices in the Security Bldg., Los Angeles.

Mr. C. Gordon Reel, Assoc. M. Am. Soc. C. E., has been removed from his office as State Superintendent of Highways of New York by Governor Sulzer. Mr. Reel was formerly a consulting engineer of Kingston, N. Y., and previous to his appointment as Superintendent he had served as Deputy Superintendent.

Mr. Nicholas L. Smitham, formerly Master Mechanic of the Texas Central R.R., has been appointed Assistant Superintendent of Motive Power of the Missouri, Kansas & Texas Ry. of Texas, with headquarters at Denison, Tex. Mr. Smitham's railway experience began as a boiler maker's apprentice with the Lehigh Valley R.R. in 1877.

Mr. E. E. Clark, a member of the Interstate Commerce Commission since 1906, has been elected Chairman, succeeding Mr. Franklin K. Lane. Mr. Clark entered the railway service in 1873 and for several years was a train conductor. From 1890 until his appointment to the Interstate Commerce Commission he was the head of the Order of Railway Conductors of America.

Messrs. Harry L. Maier, Assoc. M. Am. Soc. C. E., and William J. Horrigan, Jun. Am. Soc. C. E., announce the organization of the firm of Maier & Horrigan, Consulting Engineers, Ford Bldg., Wilmington, Del. Mr. Maier was formerly Assistant Engineer of the street and sewer department of Wilmington, and Mr. Horrigan has been President of the Horrigan Construction Co., of Wilmington.

Mr. C. G. Elliott, M. Am. Soc. C. E., former Chief Engineer of the U. S. Bureau of Drainage Investigations, was reinstated on Mar. 4, by Secretary of Agriculture Wilson. Mr. A. D. Morehouse, Assistant Engineer, was also reinstated. The reinstatement of Mr. Elliott is reported to have been the last official act of the Secretary of Agriculture by whose order Messrs. Elliott and Morehouse were summarily dismissed on Feb. 3, 1912.

Mr. Herbert S. Balliet, Engineer of Maintenance-of-way of the Grand Central Terminal, New York City, and Signal Engineer of the Electric division of the New York Central & Hudson River R.R., has been appointed Assistant Manager of the Grand Central Terminal. He will continue to perform his present duties as Signal Engineer and Engineer of Maintenance-of-way. Mr. Balliet was formerly Assistant Signal Engineer of the Lehigh Valley R.R.

Mr. R. F. Morkill, Assoc. Am. Inst. E. E., recently Electrical Engineer of the Railway Signal Co. of Canada, Ltd., Lachine, Que., has been appointed Signal Engineer of the Grand Trunk Ry., with headquarters at Montreal, Que. Mr. Morkill was formerly Signal Engineer of the Central South African Ry. Later he was connected with the New York City office of the Union Switch & Signal Co., and with the signaling department of the Pennsylvania R.R.

Mr. David B. Reger has been appointed Assistant Geologist on the staff of the West Virginia Geological Survey. The position is a new one created by the recent session of the legislature. Mr. Reger served as Field Assistant in the United States Geological Survey from 1903 to 1906, and as Chief Hydrographic Surveyor at the United States Naval Station at Guantanamo, Cuba, in 1906 and 1907. He has been Field Assistant with the West Virginia Geological Survey from 1908 until the present time. Mr. Reger is a graduate of the West Virginia University.

Mr. Alfred H. Smith has recently been promoted to be the Senior Vice-President of the New York Central Lines. Mr. Smith began his railway career in 1881 in the construction department of the Lake Shore & Michigan Southern Ry. and in nine years had become foreman of bridges. In 1890 he was promoted to be Division Superintendent. In 1901 he was made Assistant General Superintendent and a year later General Superintendent. In 1902 he was appointed to the same position with the New York Central & Hudson River R.R., and in 1903 was promoted to General Manager, and a few years later elected a Vice-President.

Mr. Samuel T. Park, formerly Superintendent of Motive Power of the Chicago & Eastern Illinois R.R., Danville, Ill., has resigned to become President of the Monarch Pneumatic Tool Co., of St. Louis, Mo. Mr. Park entered the railway service in 1884 an an apprentice machinist of the Louisville & Nashville R.R. After various shop positions as foreman and draftsman, he became Division Master Mechanic of the Atchison, Topeka & Santa Fé Ry., at Winslow, Ariz., in 1900. He became Master Mechanic of the Chicago & Eastern Illinois R.R., in 1905, and a few months later was promoted to be Superintendent of Motive Power.

Mr. Franz Schneider, Jr., Instructor in biology and public health at the Massachusetts Institute of Technology, has resigned to become Sanitarian of the department of surveys and exhibits of the Russell Sage Foundation, New York City. This department of the Sage Foundation is a new one and its work is largely advisory, such as defining social surveys by specific illustrations, outlining the first steps toward organization for both surveys and exhibits, assisting in the selection of subjects to be covered, estimating costs, etc. Mr. Schneider will devote his time to questions of municipal sanitation and board of health organization and administration.

Dr. Homer M. Derr, Assoc. M. Am. Soc. C. E., Professor of civil engineering at the South Dakota State College, has been appointed State Engineer of South Dakota, succeeding Mr. Samuel H. Lea, M. Am. Soc. C. E., resigned. Prof. Derr grad-

uated from Leland Stanford, Jr., University in 1898 and received an A. M. degree from Columbia University in 1901. For a year he was Instructor in mining engineering and geology at the University of Wyoming. He received the degree of Ph.D. from the University of Pennsylvania, in 1903, and for a short time was Superintendent of the Santa Margarita Mining Co., of Colombia, South America. Returning to this country he was for two years Professor of mathematics and civil engineering at the Clarkson School of Technology. In 1907 he was appointed Professor of civil engineering at the South Dakota State College.

Mr. R. C. Falconer, M. Am. Soc. C. E., who is Acting Chief Engineer of the Erie R.R., succeeding Mr. H. H. Althouse, resigned, as noted in our issue of Feb. 20, was born in Elk County, Penn., Mar. 21, 1874. He graduated from the University of Wisconsin in civil engineering in 1895. For the first four years after graduation he was engaged in structural steel designing, first with Purdy & Henderson, New York City, and later with the Cambria Steel Co., of Johnstown, Penn. In 1899 Mr. Falconer entered the service of the Pennsylvaia R.R. Lines West of Pittsburgh, as a transitman and was in charge of third and fourth track work between the Allegheny and Conway yards, of Pittsburgh track elevation and other work. In 1901 he accepted a position with the American Bridge Co., as Contracting Engineer at Pittsburgh, Penn. The two years following 1902 he was Superintendent of the Pittsburgh Zinc Co., Contracting Engineer of the Walton Iron Co., of Cincinnati, Ohio, and Designing Engineer with the McClintic-Marshall Co., of Pittsburgh. Mr. Falconer joined the engineering staff of the Erie R.R. in 1905 as Assistant Engineer in charge of surveys and construction work. In 1911 he was promoted to be Division Engineer of the New York division and a year later Principal Assistant Engineer of the Eastern lines. In February of this year he was made Superintendent of Construction, with the duties of Chief En-

OBITUARY

Philip Henry Coombs, M. Am. Soc. C. E., City Engineer of Bangor, Maine, died at his home in Bangor, Mar. 6. Mr. Coombs was 56 years old and had been City Engineer for nearly 30 years.

J. Lasseter, Superintendent of the Southern Ry., at Selma, Ala., died in his private car near Meridian, Miss., Feb. 27. He was 53 years old.

John R. Price, the veteran railway contractor whose death was briefly noted in our issue of last week, was known to a wide circle of the engineers who supervised the construction of the first railways into the Southwest and Mexico. It has been estimated that Mr. Price was contractor for at least 3000 miles of these railways. During the last few years of his life he had made his home in Turon, Kan., where he was the owner of a large ranch and flour mill. Mr. Price was born in Breckonshire, South Wales, Sept. 16, 1828. He came of a family of builders and contractors, and a bridge built by the Price family 200 years ago still spans the River Meath in Wales. As a boy he served as an apprentice stonemason; at the age of 20 years he was Superintendent of Construction on the Merthyr & Abergavenny Ry., in South Wales. In 1866 he came to American as a prospector for gold in California mines. For five years he prospected in California and British Columbia, but fortune did not favor him and he returned to his family in Wales. He soon after emigrated to the United States and entered business at Oskaloosa, Iowa, in 1872, as a railroad contractor. After building a number of railways in this part of the country he moved to Topeka, Kan., and took contracts for constructing various branches of the Santa Fé Ry. lines in Kansas and the Southwest. He was the builder of large portions of what are now parts of the Atchison, Topeka & Santa Fé Ry. system, including the famous Atlantic & Pacific R.R. through New Mexico and Arizona, of which Henry R. Holbrook and Lewis Kingman were the Chief Engineers. He was also contractor for large sections of the Iowa Central R.R., what is now the Chicago, Rock Island & Pacific Ry., the Chicago & Alton R.R. and the St. Louis & Omaha R.R. One of his most famous works was the construction of the Kinsley cut-off from Hutchinson to Kinsley, Kan., for the Santa Fé Ry. This long held the record for fast railway building—84 miles of completed grade and track in 90 days. Another notable contract held by Mr. Price was for the construction of the Mexican Central Ry., from San Luis Potosi to Tampico, Mex. His last work in railway building was the construction of a line from Osage City to Ottawa, Kan., a private enterprise which was afterward sold to the Atchison, Topeka & Santa Fé Ry.

ENGINEERING SOCIETIES

COMING MEETINGS

AMERICAN RAILWAY ENGINEERING ASSOCIATION.
Mar. 18-21. Annual convention at Chicago, Ill. Secy., E. H. Fritch, 900 S. Michigan Ave., Chicago, Ill.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Mar. 19. Annual meeting at Boston, Mass. Secy., S. E. Tinkham, 715 Tremont Temple, Boston, Mass.

AMERICAN CHEMICAL SOCIETY.
Mar. 25-28. Annual meeting in Milwaukee, Wis. Secy., C. L. Parsons, Box 505, Washington, D. C.

NATIONAL FIRE PROTECTION ASSOCIATION.
Mar. 26-27. Annual meeting in New York City. Secy., Ralph Sweetland, 141 Milk St., Boston, Mass.

NATIONAL BUILDING TRADES AND EMPLOYERS ASSOCIATION.
Mar. 26-27. Annual convention at Washington, D. C. Secy., J. H. Scates, 15 E. Fayette St., Baltimore, Md.

NEW ENGLAND STREET RAILWAY CLUB.
Mar. 27. Annual meeting at Boston, Mass. Secy., H. A. Faulkner, 12 Pearl St., Boston, Mass.

AMERICAN ELECTROCHEMICAL SOCIETY.
Apr. 3-5. Annual meeting at Atlantic City, N. J. Secy., J. W. Richards, South Bethlehem, Penn.

NATIONAL DRAINAGE CONGRESS.
Apr. 10-12. Annual convention at St. Louis, Mo. Vice-Pres., E. T. Perkins, Chicago, Ill.

DETROIT ENGINEERING SOCIETY.
Apr. 18. Annual meeting at Detroit, Mich. Secy., F. H. Mason, 614 Moffat Bldg., Detroit, Mich.

UTAH SOCIETY OF ENGINEERS.
Apr. 18. Annual meeting at Salt Lake City, Utah. Secy., R. B. Ketchum, 702 Newhouse Bldg., Salt Lake City, Utah.

SOUTHERN GAS ASSOCIATION.
Apr. 18-20. Annual meeting at Charlotte, N. C. Secy., E. D. Brewer, Atlanta, Ga.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION.
Apr. 24-26. Annual convention at Waterloo, owa. Secy., H. E. Weeks, Davenport, Iowa.

NATIONAL CONFERENCE ON CITY PLANNING.
May 5-7. Annual conference at Chicago, Ill. Secy., Flavel Shuetleff, 19 Congress St., Boston, Mass.

GAS, ELECTRIC AND STEEL RAILWAY ASSOCIATION OF OKLAHOMA.
May 6-8. Annual convention at Oklahoma City, Okla. Secy., H. V. Bozell, Norman, Okla.

AIR BRAKE ASSOCIATION
May 6-10 Annual convention at St. Louis, Mo. Secy., F. M. Nellis, 53 State St., Boston, Mass.

Idaho Society of Engineers—At the fourth annual convention of the Society on Feb. 21-22, at Weiser, Idaho, the following officers were elected for 1913: President, J. P. Congdon; Vice-President, R. J. Wood; Treasurer, Edward Hedden; Secretary, J. F. Shaffner. Highways and irrigation problems were the main subjects discussed at this meeting. An inspection trip was made to the Oxbow power site on Feb. 23.

Wisconsin Electrical Association—The annual meeting of the Association was held at Milwaukee, Wis., on Jan. 15, at which time the following officers were elected for the ensuing year: President, W. H. Winslow; Vice-Presidents, William Wallen, P. H. Korst, and M. C. Ewing; and Secretary-Treasurer, George Allison.

American Society of Engineering Contractors—At the fourth annual meeting of the Society in New York City, Jan. 14, the election of officers for 1913 resulted as follows: President, H. J. Cole; Vice-Presidents, Edward Wegmann, and G. T. Clark; Secretary, J. R. Wemlinger; and Directors, A. S. Bent, DeWitt V. Moore and L. F. Peck. A movement was started for the inauguration of an Information Bureau for the benefit of members of the Society.

American Chemical Society—The following papers, among those on the program of the annual meeting at Milwaukee, Wis., on Mar. 25-28, are worthy of notice: "Industrial Chemistry," by M. C. Whitaker; "Agricultural and Food Chemistry," by G. F. Mason; "Biological Chemistry," by I. K. Phelps; and "Chemical Education," by J. F. Norris. The arrangements have been planned so that technical sessions will be held in the forenoon each day, excursions in the afternoon and entertainment features in the evening.

National Fire Protection Association—The annual meeting of the Electrical Committee will be held on Mar. 26-27, in New York City, at which discussion will be held on proposed changes in the "National Electric Code." Among the prominent engineering societies represented on this committee are the American Institute of Electrical Engineers, American Electric Railway Association, National Electric Contractors' Association and National Electric Light Association.

ENGINEERING LITERATURE

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EDITORIAL

The Dewey Decimal System of Classification Extended to Engineering

So much has been written and said about indexing and filing engineering literature and so many systems have been described and recommended that engineers will be interested in knowing what the standard library methods are; and perhaps think it best to adopt them for their own use. We have received letters indicating that many engineers and manufacturing firms have already adopted the Dewey decimal system or a similar one for classifying, indexing and filing current technical articles, trade catalogs, etc., and its advantages over any irregular, haphazard system are undoubtedly very great.

The Dewey system divides all knowledge into nine classes numbered from 1 to 9, such as Philosophy, Religion, History, etc. Under this classification 6 is Useful Arts, within which is found Engineering. Each general heading is subdivided as follows: Useful Arts 600, Medicine 610, Engineering 620, Agriculture 630, etc. Each subhead is further subdivided as Mechanical Engineering 621, Mining Engineering 622, etc. Each of these in turn may be elaborated indefinitely as for example Mechanical Engineering into Steam Engineering 621.1, Mechanism of Steam Engine 621.11, Types of Engines 621.112, and so on, making a new decimal point every three figures.

The great advantage claimed for the Dewey system is that it can be expanded indefinitely; and when applied to all human knowledge to be grouped and classified and filed for all kinds of people it would indeed be difficult to hit upon a scheme so well adapted to give the best possible satisfaction. Applied, however, to an index and a file maintained primarily for a given purpose, as an aid to the business of an individual or single firm or corporation, it is more elaborate than necessary, and its very elaborateness at once leads into difficulties.

As an example we will give an instance of actual experience. It was suggested to us to put the Dewey classification number on the articles listed in our table of contents, so that engineers could file the articles according to that system.

From a single individual's point of view this is very easily done. But we will take an article at random, say "Explosion-Proof Electric Equipment for Mining Service," in our issue of Feb. 20. The article deals with a number of investigations of devices for rendering electric motors and switches safe for use in gaseous mines.

The electrical engineer keeping a file for his own use would probably classify this under Electrical Engineering Dynamo Electric Machines, etc., 621.312.....etc. A mining engineer might look at it from an entirely different point of view and classify the article under Mining, Ventilation and Lighting of Mines, Motive Power for Mine Fans, Electricity, 622.445.3, or under Lighting, Safety Lamps, etc., 622.47, or under Dangers and Accidents, 622.8...etc.

Obviously to be completely indexed or filed it should appear under all these and more, or there should be cross-references. This is what a professional librarian aims to do, but any one who has had much to do with public libraries and library indexes knows that such articles or books are not indexed under enough headings to give the searcher all the available information in the library on the subject of his search. Of course it is a physical impossibility to carry out such a system of indexing in an ideal way so that each heading gives all references or cross-references to the subject matter in all the books and articles in the library. An index complete enough to do so would require a building by itself.

Whoever has tried to make an index for general use, quickly meets the question of when to stop indexing a given article or book. The more knowledge the indexer has of the subject matter in the book or article, the harder such a limit is to determine, because he realizes that there are very valuable data there to which the title or general heading gives no clue. In fact, a single chapter in a good book by an experienced author may be more valuable to the searcher than a dozen poor books devoted to the particular subject treated in that chapter.

Another random example of a shortcoming in the Dewey system is the classification of Surveying. We doubt if any person who has studied or practiced surveying would think of classifying a description of a survey which contains data of value on the art of surveying under Mining, Drainage, Railway Location, or any other heading designating the purpose of that particular survey. Yet under the Dewey system we have no general classification Surveying, but must put the entry under every branch of engineering work which involves a use of surveying, in order that the subject shall be available to every searcher. Carried out in detail this system would separate correlated articles so far apart in the files that to find all the articles wanted for information on surveying would require a most thorough search and study. As

the file grows the more widely separated allied subjects become.

These are, as we said, mere random illustrations. We do not wish to belittle the work done by the inventor of the Dewey system, or those who have extended it. In principle, it is an exceedingly simple solution of a complex problem. We merely suggest that any engineer who will study the system and get its fundamental principles can undoubtedly work out a system of classification of his own, which, from his own expert knowledge of the subjects to be classified, will be more convenient for his purposes than the elaborate Dewey system extended as is done in two recent publications designed for engineers: "An Extension of the Dewey Decimal System of Classification Applied to the Engineering Industries," by L. P. Breckenridge and G. A. Goodenough, University of Illinois *Bulletin*, Nov. 11, 1912, Vol. 10, No. 11 (Price $0.50), and the October, 1912, *Quarterly* of the Colorado School of Mines, Vol. 7, No. 3. The latter of these is for mining and metallurgical classification, while the former purports to give a system of classification for all engineering literature.

Each of these pamphlets has a relative index at the end which will help considerably in determining under what classification to look for a given subject. The following is an example, purposely an example of poor terminology, taken from the first mentioned pamphlet:

Sewerage
Discharge of into sea.
Deodorization and disinfection of,
Disposal of,
Farming,
Irrigation, etc.

It is only fair to say that this heading and these classifications are the work of a Professor and an Associate Professor of Mechanical Engineering. Yet they go to show how individualistic any classification is; and no man with ideas of his own and a little ingenuity need accept unqualifiedly a system which, with a little consideration of his own needs and uses, can be much improved upon. And unless one aspires to be a professional librarian we doubt the value of his mastering the minute classifications required to use the Dewey system with all its ramifications.

CORRESPONDENCE

A Reply to Review of "Engineering of Shops and Factories"

Sir—The review of my book, "Engineering of Shops and Factories," printed in "Engineering News," of Feb. 13, 1913, states:

It contains also some chapters on location and planning, and on certain items of equipment, such as heating and lighting, air washing, sewerage, etc. But in examining these chapters it becomes evident that the subjects are not the author's own, etc.

This statement is misleading and might give the impression that I have used the writings of others without giving credit. The fact is that material for several chapters on shop equipment was supplied by specialists in certain lines, whose names are given in my book. Furthermore, the fact that these chapters were written by specialists is particularly emphasized in my preface, and special value is claimed for the book on that account.

H. G. TYRRELL.

Evanston, Ill., Mar. 7, 1913.

[The "etc." which Mr. Tyrrell omits in the foregoing quotation was: "and that in compiling he has missed completeness and in many instances correctness." We declared that some of the "subjects," not the language and mode of presentation, were not the author's own.

The most striking example in the book of lack of mastery of a subject appears to be the chapter on "Drainage of Industrial Plants"—which the author specifically credits to himself in a footnote. This chapter forcibly illustrates the pitfalls which beset the author or compiler who goes too far outside his own field. Since all-too many authors go astray in this fashion, to the injury of publishers and readers alike, we exhibit some of the many glaring faults in this chapter. This we will do solely by quotations, which, with the aid of blackfaced type of our own using, speak for themselves:

[P. 286, on Water Closets.] They should have a tight valve and a double water seal, with water enough under the seat for immediate **disinfection.**

[P. 290, on The Drainage of Plants.] As a stream flows on, **its velocity will increase, and consequently its volume will diminish.** Therefore a pipe running full at its upper end, **may receive a large quantity more during its course.**

[291, on Ventilation of Sewers.] In the city of Windsor, England, in 1856, a case of typhoid fever was discovered. From lack of proper sewer ventilation, the foul and poisonous gases from the fecal matter of this one patient, rising through forced and siphoned traps, caused the death of no less than 450 other persons, all of whose houses without exception were connected with this sewer. Windsor Castle, having its own drain, escaped. In another city, the breaking out of typhoid fever in the higher parts of the town **while the lower portions remained untouched** was considered a mystery until it was found that the sewers, not being properly arranged, allowed the poisonous gases to rise to the higher parts of the system, where they escaped and spread the germs of disease. In this, as in many other cases, the community was stirred to action only by the cruel hand of pestilence.

[Pp. 293-4, on Pneumatic System.] All elements have been called upon as aids in the **drainage** of communities, including water, **dry earth and ashes,** and now the aid of compressed air is used in removing refuse from buildings. On account of its **comparatively recent discovery,** this system is but little used, but in Holland and Austria where it has been tried, good results have been obtained. It is to the research and ingenuity of a Dutch engineer that the world is indebted for the discovery of a system which has been declared as **the greatest modern invention in sanitary science.** * * * * * As the sewage at the final depot is run through sieves, and evaporated for use as fertilizer * * * * * * the income from the sale of the product soon pays for the extra cost of construction.

[P. 294, on Conservation of Sewage.] With the water system, refuse run into the lakes or ocean is lost, as far as the present era of the world is concerned. * * * * *

By discharging its sewage into a lake or waterway, a city of 100,000 loses annually no less than $70,000. Assuming the present population of the United States to be 90,000,000 the nation loses annually from this waste $60,000,000 to $70,000,00.

At Coventry, England, the liquid sewage is rendered **harmless** by mixing it with sulphate of alumina. * * * * * The solid matter from the sewer, after being separated from the liquid, is dried and sold as a fertilizer for the land. **In order that the discharge may be more copious various storage tanks have been devised, so that when a flow occurs it will be dispersed over a greater area of land.**

Another method of sewage disposal is that of ignition. The **precipitated sewage** is first run into shallow pits where it is partially dried, after which it is burned in large kilns. This method, although producing no revenue from the waste, and on the other hand creating some expense, has the advantage of immediately and thoroughly destroying the source of disease, which is far better than storing up evaporated excreta with the expectation of selling it, and the liability of spreading sickness throughout the country.

[Conclusion, p. 296.] **From the above it appears that large manufactories instead of incurring constant expense for the disposal of sewage can cause it to be a source of revenue,** and streams may continue pure and clean instead of being polluted as they so often are with dyes and refuse from shops and mills.

It is only fair to say that the chapter on "Drainage" appears to be the worst example in the book of "subjects" which are "not the author's own."—ED.]

REVIEWS AND NOTES

English for Engineers

Reviewed by H. P. BREITENBACH*

A HANDBOOK OF ENGLISH FOR ENGINEERS—By Wilbur Owen Sypherd, Professor of English in Delaware College. Chicago and New York: Scott, Foresman & Co. Flexible leather; 4x7 in.; pp. 314. $1.50.

Attractively bound in black leather, with rounded corners, and of convenient pocket size, Sypherd's "Handbook of English for Engineers," in its outward appearance well bears out the suggestion of its name. Its contents are intended to be "of practical assistance to engineers in college classes and in the early years of professional life." The author's modest aim should easily be fulfilled by the book. In preparation for his task he has faithfully read the literature available on the subject, and his book bears evidence of painstaking care. While his strength has lain in compilation and selection rather than in origination, Prof. Sypherd has made a useful contribution in a field that is rapidly increasing in importance.

The book contains five chapters, devoted respectively to General Problems of Engineering Writing, Mechanical Details Common to the Various Forms of Technical Writing, Business Letters, Reports, and Articles for Technical Journals.

The first chapter is chiefly remarkable for its direct and simple approach to the problems of technical writing. The author here, as generally elsewhere in the book, avoids the usual formal terms of rhetoric. In the second chapter are included directions for the use of abbreviations, punctuation marks, capital letters, etc. To engineers who desire a little strengthening of their English these two chapters are likely to be most serviceable.

The chapter on business letters briefly states the main principles governing successful business correspondence and supplies examples of good and bad usage. One important omission may be noted here. Modern business correspondence has become so voluminous that means of securing special emphasis are frequently necessary. Mention of some of these might well have been included in the chapter. It may be remarked, too, in passing that the author gives his sanction to the objectionable "Respectfully" (without the "yours") for use in the close of a letter.

In the next chapter engineering reports receive what, so far as the reviewer's knowledge goes, is their first systematic rhetorical treatment. The author discusses the general essentials of reports; then gives more fully the requirements of reports on tests, reports on inspection work, and periodical reports, with examples of each kind.

To such faithful readers of engineering periodicals as peruse the book-review columns, doubtless the final chapter, on Articles for Technical Journals, will have more than a passing interest. Dividing his subject into Short Articles and Longer Articles, Prof. Sypherd includes under the former head editorials, summaries and abstracts, book reviews and explanations of new inventions. Not to dwell upon the unpedagogical and illogical order in which these are presented, it is noteworthy that the author's main generalization on editorial writing is unwarranted either by current editorial practice or by the examples he himself cites. He says:

> Following the practice of most editorial writers, he (the student) should, as a rule, express the main point or the general thought of his paragraph in the first sentence.

In both this dictum and throughout his discussion of technical journalism, the author does not sufficiently recognize the increasing importance in present-day journalism of fact-statements.

The last chapter of the book, in short, is likely to be least satisfactory to both student and practicing engineer. It is subject to one other criticism, which applies more or less throughout the book. Of the 85 pages which this chapter contains, some 75 are devoted to examples. In a book which purports to be a handbook, such copious use of illustrative material would be justifiable only if it were elsewhere scarce. But, of course, good examples of technical writing are to be found today in every issue of nearly every first-rate technical journal. Furthermore, the articles selected, with possibly a single exception, have little general or permanent value. "Thawing Pipes by Electricity," for instance, may be well worth while as a timely article, but neither its rhetorical form nor its content value justifies its inclusion in an engineer's handbook.

But that the author, in a field where so much pioneer work remains to be done, has occasionally missed the right path, is easily condoned. The book should prove useful in higher engineering classes, and doubtless will find a place on the reference shelves of many progressive engineers.

With a view to the former use, the author has supplied, in connection with the various chapters, assignments for composition work. Appendices contain further useful pedagogical material, including a bibliography of the subject. The bibliography includes references on contracts and specifications, but in the book proper there is only casual mention of these subjects.

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FORESTRY IN NEW ENGLAND—A Handbook of Eastern Forest Management. By Ralph Chipman Hawley, Assistant Professor of Forestry, Yale University, and Austin Foster Hawes, State Forester of Vermont and Professor of Forestry, University of Vermont. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6x9½ in.; pp. 474; 140 text illustrations. $3.50, net.

There is reason for congratulation in the fact that forestry in the United States has made sufficient progress to warrant the publication of a book devoted to "the specific forestry problems" of one section of the country.

The volume before us deals first with forestry in general and then takes up forest conditions, practices and possibilities in New England. Much of Part II is applicable to considerable portions of New York, New Jersey, Pennsylvania and southeastern Canada, while Part I is of general application—although for complete treatment the authors refer their readers to other and more extended works.

Confining our further remarks chiefly to Part II, New England Forests and Their Management, we note that the authors first review briefly the original forests of New England and their early development and also present forest conditions. Having divided New England forests into four regions—Spruce, Northern Hardwoods, White Pine and Sprout Hardwoods—each region is taken up in detail. The main heads here employed are General Considerations; Forest Types; Methods of Handling the Forests (of each type); Logging Methods; Market Conditions; Industries (using lumber, etc.); Character of the Land and Ownership; and Forest Protection. Two folding maps show the location of the four regions and also the railways which serve them. These four chapters contain a large amount of practical information, useful alike to students of forestry and to present or prospective owners of forest lands (actual or potential) in New England and its adjacent territory.

Particularly interesting in this and other sections of the book are the facts and opinions regarding the availability of large areas of New England lands for forest improvement and for afforestation by city people who wish to own farms in the country, either for summer use or as retreats after their active business careers are ended. Such persons will find forestry less exacting than farming, both in point of continuous supervision and drain upon the purse.

A chapter on The Progress of Forestry in New England presents a systematic review of what has been done up to 1912 by each of the six states. While much remains to be done, it is a pleasure to note how good a beginning has been made in most of the states and that each state is doing some forestry work.

A brief final chapter deals with possible forest yields under proper management. An appendix contains some statistics of forest fires, a brief bibliography and 40 pages of tables for finding volumes of logs, the growth of individual trees, and the yields of whole stands or forested areas.

The book should stimulate forestry work in New England and deserves a wide circulation there and in adjacent districts. The halftone illustrations are notable for choice of subjects and for the high character of the original photography, the engraving and the presswork.

❖

WIRELESS TELEGRAPHY AND TELEPHONY SIMPLY EXPLAINED—A Practical Treatise Embracing Complete and Detailed Explanations of the Theory and Practice of Modern Radial Apparatus and Its Present Day Applications, Together with a Chapter on the Possibilities of Its Future Development. By Alfred P. Morgan, Editor, Mechanical and Electrical Department of the "Boy's Magazine," author of "Wireless Telegraph Construction for Amateurs." New York: The Norman W. Henley Publishing Co. Cloth; 5x7½ in.; pp. 154; 156 illustrations. $1.

The book contains a good deal of valuable information on wireless apparatus and operation with a large amount of speculation as to future developments. While not in any sense a scientific work nor entitled to be called a practical treatise, the book should prove of interest to many who

desire simply a little non-technical information concerning recent scientific advances.

A number of the conventional circuit diagrams shown in various parts of the book might interest the amateur operator. A creditable attempt is made to explain by simple analogies the theories of detectors, resonant circuits, tuning, couplings and directive siginaling, and the principal pieces of wireless apparatus in common use are described.

The book gives a wrong impression, more by implication than by positive statement, of the present importance of wireless telephony. Much has been actually accomplished in this field in the way of perfecting sending and and receiving apparatus, but for the lack of an adequate selective device, the wireless telephone is still about as far from commercial applicability as it ever was.

Perhaps the feature of the book which stands out most prominently is the large extent to which it is illustrated. It is a matter for regret that more attention is not paid by technical writers in general to the use of pictorial descriptions.

⁂

Measuring Electrical Resistance

Reviewed by C. H. SHARP*

METHODS OF MEASURING ELECTRICAL RESISTANCE—Edwin F. Northrup, Ph. D., M. A. I. E. E. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xiii + 389; 1505 text illustrations. $4 net.

When a book on a restricted field in electrical measurements, such as the measurement of electrical resistance, is announced, it is likely to raise a question as to whether there is sufficient material in this subject alone to justify a book being written on it. The present work, which extends to nearly 400 pages, is a sufficient answer to that question, and is furthermore a striking evidence of the great extent to which the science of electrical measurements has been carried.

The measurement of electrical resistance in an especial way demands an extended treatment, because measurements of resistance occupy, in the present state of the art, a fundamental position among electrical measurements. Not only is resistance one of the three factors of Ohm's law, but it is in practice one of the two which lie at the basis of all electrical measurements. Current strength is a derived quantity, the standard resistance and the standard cell furnishing the means for its measurement.

This work treats of the measurement of resistance in practically all of its phases. The treatment is essentially practical, there is a marked and very welcome absence of mathematical gymnastics and a decided leaning toward simple and common-sense treatment.

The author starts out with a very excellent treatment of the subject of accuracy, of the question of relative errors and of the necessity of forming a discriminating judgment as to the relative importance of quantities, and as to the accuracy required in various factors. The theory of errors is discussed in a simple and adequate manner.

Next are taken up the voltmeter methods of measuring resistance, including one method original with the author. In this chapter, as in all the following ones, numerical examples are given, mostly from practical experiments, which illustrate the application of the methods, and which indicate their limitations and their accuracy. This feature of the book is most commendable.

A single paragraph is given to direct reading instruments for the measurement of resistance, these being classed as "ohmmeters and meggers." To the reviewer it seems unfortunate that the principle of the latter class of instruments is not more fully explained, particularly since the so called "megger" is not the only deflection instrument which is direct reading in ohms. The explanation that these are instruments rather than methods of measurement seems hardly adequate, in view of much that follows. The principle of these instruments is due to Maxwell, and the modern types have a considerable commercial importance.

Null methods are next discussed, the differential galvanometer being treated and the various forms of bridges. The Wheatstone bridge is considered in great detail, the Cary-Foster bridge being rightly treated as a Wheatstone bridge with mechanical accessories which serve for switching purposes. The arrangement of resistance boxes is taken up in detail, great attention being paid to the method of connecting coils. It might be objected that this does not come under the head of methods of resistance measurement, but criticism is disarmed by the fact that the matter treated of is valuable and pertinent and that the author speaks with authority.

In considering methods of measuring low resistance, the author takes up first those which are available for the measurement of the resistance of a continuous conductor carrying a current, such as a busbar or as an underground pipe through which a stray current is flowing, and proceeds next to a discussion of the Kelvin double bridge. This bridge method which, not many years ago, was but little known in practice, has come to have a recognized and very important place in enginnering measurements. It is treated in a very clear and adequate way.

Commercial conductivity measurements are next taken up and commercial apparatus is considered. The treatment here would be more complete if the method which is in use at the Electrical Testing Laboratories were described. This method consists briefly in the use of fixed conductivity standards of copper, with which the resistance of a measured length of the unknown sample is compared. The measured length is so chosen in relation to the weight per unit length of the sample, that if the sample has 100% conductivity, its resistance will be equal to that of the standard. Using a Kelvin double bridge, a comparison of the relative resistance of the standard and of the measured length of the sample is made, and the result shows the percentage conductivity directly.

High resistance measurements by deflection and by loss of charge are adequately treated and the theory of galvanometer shunts is taken up at this point. In this connection also the peculiarities of cables with respect to time of charge, etc., are discussed.

A relatively new type of resistance measurements is next considered; namely, the measurement of resistance of conductors with alternating currents flowing through them. Alternating current resistances are particularly important in the case of conductors composed wholly or partly of iron, such as steel cored wire, railway rails, etc.

Further chapters discuss the practical questions of the resistance to earth, of electric distribution systems, as measured with the power on. The measurement of the resistance of electrolytes is discussed, and a long chapter is devoted to the theory of the location of faults in cables. The latter subject is treated in a very practical way with adequate diagrams and numerical examples.

The book concludes with a discussion of the measurements of the resistance of resistance thermometers and with general considerations as to the construction of standards and as to the behavior of galvanometers.

In the Appendix, various useful data are given, not the least valuable of which are collections of constants of galvanometers of different types and different makes, and of the resistivity of various elements and alloys.

A book of this character demands close attention on the part of the reader. Anything which distracts the attention needlessly is a detriment. It may, therefore, be asked whether, in view of the present common usage in spelling, the total efficiency in the use of language in this book would not have been greater if the word "through" had been spelled in the usual manner rather than in a way dear to the hearts of spelling reformers but annoying to the old-fashioned reader who resents textual idiosyncracies which interrupt the continuity of his train of thought. Is a seriously intended textbook any proper place for the exploitation of orthographic experiments anyway? Apart from this blemish the reviewer has nothing but commendation for the mechanical makeup of the book.

It may be said in conclusion that the book is of a very practical character and commends itself highly to engineers whose work brings them into touch with resistance problems. The long experience which the author has had, both as a designer and user of electrical instruments, enables him to speak with peculiar authority and with much commonsense on the various topics which he has treated.

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THE CURTISS AVIATION BOOK—By Glenn H. Curtiss and Augustus Post. With Chapters by Captain Paul W. Beck, U. S. A., Lieutenant Theodore G. Ellyson, U. S. N., and Hugh Robinson. New York: Frederick A. Stokes Co. Cloth; 5x7 in.; pp. x + 307; numerous illustrations. $1.35, net.

This is surely a Curtiss book. It is Curtiss from cover to cover—the Curtiss story as told by himself and as told by others. Mr. Post first tells of Curtiss' life, his boyhood days, his speed mania and how it all led him into the manufacture of motor-cycles, and how this in turn got him into touch with T. S. Baldwin, of dirigible-balloon renown.

From this point on Mr. Curtiss' interest in aëroplanes is discussed by himself. He modestly speaks of his own work in collaboration with Alexander Graham Bell, S. W. Baldwin,

*Electrical Testing Laboratories, 80th St. and East End Ave., New York City.

J. A. D. Macurdy, Lieut. Selfridge and Mr. Post. It is an interesting narrative, compelling in its simplicity, directness, and vividness, especially where Mr. Curtiss tells of his races abroad. His love for fast travel shows itself, but the reader gets the impression also that he is now leaving that behind him for his greater delight in making various machines that will travel fast, and in surmounting all the possible obstacles to their dependable operation.

Curtiss tells his own story of the development of the hydro-aëroplane which has now reached the stage of a feasible land-water flying boat. Capt. Paul Beck, U. S. A., and Lieut. T. G. Ellyson, U. S. N., who were among the officers detailed for instruction and duty under Mr. Curtiss, have contributed chapters on the use of the aëroplane in the army and navy. Capt. Beck gives a somewhat theoretical discussion of its military aspects; Lieut. Ellyson performs a similar task, but adds a little on the life in 1911 at the San Diego experimental station where most of the development work was done on the hydro-aëroplane. There are various chapters on amateur work in learning to fly, and on the detailed construction of the Curtiss machine. Most of these are by Mr. Curtiss, but a few are by his associates.

The role played by Mr. Post in this work is worthy of passing mention. When the publishers feel that some references to Mr. Curtiss and his work, which his own modesty conceals, are needed, then the tale is told by Mr. Post, either in an interjected chapter or as a footnote. Mr. Post's contributions show on their face a Boswellian character. He seems to have industriously collected newspaper clippings about his most interesting chief, and have noted down in an ever-present notebook Mr. Curtiss' remarks at the theater and in his bath.

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A German Pocket Book for Sewerage Engineers

Reviewed by EMIL KUICHLING*

TASCHENBUCH FUER KANALISATIONS-INGENIEURE—By Dr.-Ing. K. Imhoff. Drawings by O. Bernards. Second edition. Munich and Berlin: R. Oldenbourg. Cloth; 4¼ x 6¾ in.; pp. 29; 16 pp. of diagrams. Marks, 2.80.

A brief compendium of the principles of sewerage and sewage disposal is presented in the small space indicated above. Each subject is discussed in comparatively few words, and wherever possible reference is made to the diagrams which represent the underlying mathematical and physical data. These diagrams relate to the prospective increase of population in a community, the rainfall, runoff, size of sewer section, and the mean velocity and discharge for different depths of flow in twelve sections of different shape. The diagrams in the latter series are novel and ingenious, as every form of cross-section considered is expressed in terms of a circle whose diameter is equal to the maximum width of the given section.

It is obvious that a complete review of this publication would require much more space than is here available, and hence only a few of the important features of sewer design will be considered. Diagram 3 exhibits the relation between the maximum intensity of rainfall, expressed in liters per hectare per second, and its duration in minutes, as observed for the Emscher drainage district. The equation of the curve showing this relation in the case of a municipal sewerage system is not given, but the writer has deduced it approximately as follows:

$$i = \frac{5.217}{\sqrt{5.8 + t}}$$

where (i) is the expected maximum intensity of rainfall, expressed in depth in inches per hour (or cubic feet per acre per second), and (t) is the duration of such intensity in minutes. This shows that for (t) = 10, 30, 60 and 120 minutes, the values of (i) adopted for said district are respectively = 1.31, 0.87, 0.64 and 0.47 in. per hr. It may be noted that these values of (i) are very much smaller than those which have been observed to occur in our New England and Middle States.

Diagram 4 exhibits the approximate relation between the runoff in liters per hectare per second reaching the sewers, and the magnitude of the municipal drainage area in hectares. Three curves are given, referring respectively to densely built-up districts with good grades, to average conditions, and to sparsely built-up districts with flat grades; but their equations are omitted, and the writer has deduced the following approximate expressions from the given curves: (1) For densely built-up areas $q = \frac{1.301}{A^{\frac{1}{8}}}$, (2) for average municipal areas $q = \frac{1.303}{A^{\frac{1}{5}}}$, (3) for sparsely built-up areas $q = \frac{1.514}{A^{\frac{1}{4}}}$, where (q) is the quantity of storm-water reaching the sewer in cubic feet per acre per second, and (A) is the area of the given sewer district in acres. (The fractions following (A) are exponents). These expressions are interesting, as they exhibit the principle on which the author computes the volume of storm-water to be provided for in sewers. No proof of the correctness of these curves, however, is offered, and hence further comment is excluded.

For computing the mean velocity and discharge in a given sewer cross-section, the author uses an abbreviation of the Kutter formula commonly adopted by German and French engineers. Reduced to measure in feet, this formula is approximately:

$$v = \left(\frac{178.56\sqrt{r}}{0.600 + \sqrt{r}}\right)\sqrt{rs}$$

in which the degree of surface roughness is n = 0.0135, and the factors (r) and (s) have their usual significance. No comment on this convenient abbreviation of a cumbersome formula is required, except to remark that in sewer work its use will give as trustworthy results with a given value of (n) as the unabbreviated formula.

Diagram 15 exhibits the relation between the diameter and the cost per unit of length of furnishing and laying sewer pipes of cast iron, earthenware, cement, reinforced concrete and large masonry conduits, exclusive of trenching; and Diagram 16 shows the necessary sinking-fund charges or percentages of original cost required with different periods of years and rates of interest. Both of these diagrams are useful for approximate work, but they are not as satisfactory as tables, which would occupy no greater space. In regard to the costs of pipes and large sewers in Germany, no comment is made as they do not apply to American conditions.

The general principles of sewage treatment are tersely set forth on pages 7-16, and many valuable data are given. Thus in regard to quantity of sludge produced in settling tanks, it is stated that when removed in freshly deposited condition from a filled tank by pumping or hydraulic pressure, the volume will be about 0.0424 cu.ft. per head of population per day; that when the clarified liquid over such fresh sludge is carefully drawn off its volume will be about 0.0212 cu.ft. per head per day; that when the sludge is allowed to decompose thoroughly, as in a septic tank, its volume will reduce to 0.0071 cu.ft. per head per day; and finally, that in the case of a strictly separate system of sewerage, its volume, when drawn from a septic tank, may reduce to 0.0035 cu.ft. per head per day. It must be understood that these figures refer to the wet or liquid condition of the sludge as it is drawn from the tank; and in the case of septic tanks they refer only to that portion of the contents which is thoroughly decomposed, and not to the entire mass or volume of sludge contained therein.

The author regards septic tanks through which the total volume of sewage is compelled to flow as being antiquated and applicable only to small plants. Such tanks are usually designed to have a capacity of 24 hours flow of sewage. For larger plants he urges the provision of a separate compartment for the sludge in which decomposition may proceed without affecting the effluent from the settling chamber.

Many other subjects of interest in connection with the treatment of sewage are clearly and concisely presented, thus making the book a very useful addition to the library of every sewerage engineer.

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PRACTICAL DESCRIPTIVE GEOMETRY—By William Griswold Smith, M. E., Assistant Professor of Descriptive Geometry and Kinematics, Armour Institute of Technology. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. ix + 208; 132 text figures. $2, net.

Like other branches of mathematics, this one has been covered by a number of excellent treatises which have recorded the modern advances along the lines of mathematical research and drafting-room practice. But this subject, like almost any other, is capable of presenting several different appearances, depending on the point of view of the investigator; or in terms of descriptive geometry itself, depending on the "plane of projection." It is easy to see that the methods and arrangement of text which would appeal to the mathematician might and probably would be Greek to the draftsman or the student.

The author of this book, speaking from the student's viewpoint, makes the criticism that "in spite of the indisputable excellence of many of these textbooks, they seem to have failed to arouse the interest of the student, partly by ignoring the practical applications, and partly by making only a

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slight attempt to present the subject attractively." His own aim in this book, he explains, is "to present the subject to the student in a simple manner as progressively as possible, reminding him constantly of the relation which exists between Descriptive Geometry and Practical Drafting; and to avoid needless difficulty by using language and directions of the greatest possible clarity." This aim is to a large extent realized.

The book is obviously meant for the student of engineering and it appears to have found at least a partial solution for the psychological difficulties referred to above. It might also prove of interest to draftsmen and to designers on sheet-metal form work, although it contains more theory than is required by them.

The first half of the book is largely devoted to the elucidation of the fundamental theory and methods, while the practical applications are given in the succeeding portion. The sections treating of Shades and Shadows, Perspective and Isometric Projection deal with matters of interest principally to architectural students. The mechanical engineering applications are treated at length in the chapter on Curved Lines and Surfaces.

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More Books on Drawing

Reviewed by ROSSITER R. POTTER*

DESCRIPTIVE GEOMETRY—In Six Parts. By William Calvin Hoover Slagle, C. E.; Assistant Professor of Descriptive Geometry and Drawing, University of Pennsylvania. New York and London: McGraw-Hill Book Co. Cloth; 6¼x9½ in. $6 net, per set.
Part I. Projections. Pp. 94; 76 text figures. $1.
Part II. Problems of the Point, Line and Plane. Pp. 142; 284 text figures. $1.50.
Part III. Warped Surfaces. Pp. 90; 35 text figures. $1.
Part IV. Shade and Shadows. Pp. 49; 38 text figures. 75c.
Part V. Isometric Drawing. Pp. 77; 74 text figures. 75c.
Part VI. Perspective. Pp. 95; 75 text figures. $1.

ELEMENTARY MACHINE DRAWING AND DESIGN—By William C. Marshall, M. E., C. E., Assistant Professor of Machine Design, Sheffield Scientific School of Yale University: Formerly Assistant Professor of Descriptive Geometry and Drawing in S. S. S.; M. Am. Soc. M. E. New York and London: McGraw-Hill Book Co. Cloth; 6¼x9½ in.; pp. 320; 202 text illustrations. $3, net.

HOW TO READ A DRAWING—By Vincent C. Getty. Philadelphia: J. B. Lippincott Co. Cloth; 6x9 in.; pp. 64; 61 illustrations, including 19 one- and two-page plates. $1, net.

A six-volume text book on descriptive geometry requires some explanation and rather prejudices one against it at the start. The only clue offered by the author is that this treatise was inspired by the desire to present a symmetrical development of the subject and avoid the tendency to accentuate some particular division at the expense of others. Apparently he has insured against slighting any one division of the subject by making each the topic of a separate volume.

The divisions chosen as the topics of the several volumes comprise projections; problems of the point, line and plane; warped surfaces; shade and shadows; isometric drawing, and perspective. Surfaces of revolution are taken up in the volume on warped surfaces. The style of the book is in general of a formulated type rather more dry than the ordinary, although beyond criticism in regard to clearness. In fact a careful perusal of the work leads to the conclusion that in spite of its six volumes it is an ordinarily good though somewhat lengthy text book. The suggestion arises that a more reasonable price could have been set had its 545 pages been bound up in a single volume, or at most in two volumes, with no loss in convenience.

The work is not separated into chapters but is divided into portions a couple of pages or so in length by the legend "Rec. 1," "Rec. 2" etc. The same abbreviation is used in the table of contents without explanation and the preface is silent on this subject. The reviewer's guess is that this is short for "recitation." If this is correct, the work is divided into assignments for each lesson, an idea which may be worthy of imitation by other text-book writers.

Prof. Marshall's "Machine Design" is intended for use in schools rather than for home study without an instructor. However, it might be of use as a handbook by structural draftsmen or others having occasion now and then to fix the proportions of some machine detail. Rules for proportions are given together with directions for the conventional representation of rivets, pipe fittings, screws and bolts, keys and cotters, shaft couplings, stuffing boxes, bearings and shaft hangers, pistons and piston rods, cross-heads, connecting rods, engine cranks and eccentrics, pulleys and belting, spur, bevel and worm gearing, and globe valves, check valves, safety valves and stop cocks.

A feature distinguishing this from the general run of books on the design of machine details is the combination in one volume of elementary instruction in drafting, machine design and nomenclature of machine parts. The opening chapter covers the preparation of working drawings, including such elementary details as directions for erasing and for the use of tracing cloth. The other chapters, after equally elementary definitions and explanations of machine parts, take up much more advanced matters, such as the calculation of pipe diameters for steam engines and the determination of the area of least opening in a globe valve. It seems strange, incidentally, that in the chapter on rivets there is nothing in regard to the calculation of efficiencies of riveted joints.

The author has a marked fancy for graphical methods, as is evidenced by numerous diagrams for finding proportions of the various machine parts considered. Another notable feature, in connection with the problems assigned at the end of each chapter in the form of drawings to be made, is the data on the average time required for doing the work. The author states that these problems are taken from test papers that have been in use for the past ten years, which gives some weight to these figures as time-study data.

Mr. Getty's, "How to Read a Drawing," is written for those absolutely unacquainted with the principles or methods of projection drawing. So far as can be judged by one already familiar with working drawings, he has been fairly successful in presenting the subject in such a way that the reader can acquire at least the ability to understand a drawing with the minimum of effort and study. In the brief space of 64 pages, the author succeeds in covering not only the elements of the method of representing an object by a drawing, but also some of the chief points of difficulty in mechanical, architectural and structural drawing. Doubtless the best way to learn to read drawings is by making them but for one who cannot afford the necessary time and effort, Mr. Getty's book will be most helpful.

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AMERICAN CITY GOVERNMENT: A SURVEY OF NEWER TENDENCIES—By Charles A. Beard, Associate Professor of Politics in Columbia University. New York: The Century Co. Cloth; 5¼x8¼ in.; pp. 420; 14 illustrations. $2, net.

This "Survey," we learn from its Preface, is addressed "to students and citizens" who wish general information on "recent leading tendencies." It is designed to lay stress "on the social and economic functions of city government." The author believes that "the most fundamental concerns of cities" are "matters of state and national, not local, control."

In seeking to realize these aims and express these beliefs, the author discusses home rule, city democracy, municipal government and administration, all broad and more or less general subjects. He then takes up the more specific problems of city finance, police, public-service companies, municipal ownership, streets, health, tenement-house reform, education, recreation and city planning. Appendixes deal still further with franchise matters and congestion of population. A brief bibliography closes the volume.

As a review of various interesting recent tendencies along the lines indicated, the volume is commendable in subject matter and in mode of presentation. The chapters on Streets and Health (which cover paving, street cleaning, garbage collection and disposal, lighting, shade trees, water-supply, sewage treatment and fire protection) contain many statements which are sure to mislead all who have no more accurate and discriminating sources of information. This is a common fault when an author ventures too far outside his own well mastered field and attempts to garner, combine and elucidate the statements of others regarding technical matters. The results are all the worse where one makes an unfortunate choice of guides in little known fields, as portions of these two chapters and corresponding books in the bibliography plainly indicate was the case in several instances. Fortunately these chapters, and particularly the parts of them which are open to question, make up only a relatively small percentage of the whole volume.

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GENERAL SPECIFICATIONS FOR BRIDGES—By J. E. Greiner, Consulting Engineer, Fidelity Bldg., Baltimore, Md. Part I. Steel Stationary Bridges. pp. 28. Part II. Movable Bridges. Pp. 25. Part III. Substructures and Concrete Bridges. Pp. 39. [Bound separately.] Paper; 11x8½ in.

Bridge specifications from so experienced a practitioner as the author of this new work are sure to command careful

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study. The reader will find enough innovation both in substance and in arrangement to engage his interest and in most cases, we believe, his hearty approval. The pamphlet on movable bridges will doubtless rank as the most noteworthy of the three, on the ground of novelty, apart from any questions of excellence; it covers a number of questions which have usually been regarded as open, and subject to individual judgment, and makes definite provision for some items of design that have often been neglected or glossed over.

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The Development of Oil Flotation

Reviewed by F. W. TRAPHAGEN*

CONCENTRATING ORES BY FLOTATION--Being a Description and History of a Recent Metallurgical Development, Together with a Summary of Patents and Litigation. By Theodore J. Hoover, A. B., Leland Stanford, Jr., University; M. Inst. M. & M. London: The "Mining Magazine." San Francisco: Mining & Scientific Press, Agents. Cloth; 6x9 in.; pp. 221; 55 text illustrations. $3.75.

One of the most important metallurgical improvements of the present decade has been the development of oil flotation. For many years it has been known that great metallurgical losses were caused by the tendency of many sulphide minerals to float off on the water during the process of concentration. Finely divided minerals are much the hardest to concentrate and the richest tailing in ore dressing plants is usually that which is also most finely divided. Flotation processes make possible the saving of a large percentage of these small sulphide particles, a thing no other process will do.

Mr. Hoover, from his own experience and from a series of descriptions by others, has collected together much valuable information and has furnished a reliable guide on this important process.

The book is divided into 12 chapters. After a chapter each on history, patents, litigation, theories and tests, there are taken up the Potter-Delprat, the De Bavay, the Elmore Vacuum Flotation, the Minerals Separation and Other Flotation Processes. Then a chapter each is devoted to Economics and to a bibliography. The descriptions of various processes are very complete and afford not only an excellent basis for comparison, but will serve also as guides to the practice.

Considerable credit is due to the American school teacher, Miss Carrie J. Everson, who was the first to grasp and apply the important fundamental principles of oil flotation as practiced today.

Henry E. Wood's very clever work on direct flotation fails to receive notice, possibly because only recently have descriptions of the Wood's apparatus appeared.

The bibliography is excellent, very complete and will serve as a guide to the scattered literature of this very interesting field of metallurgy. Hoover concludes his book with these words:

> As a demonstration of the utility of the invention, we may say then that it has already added to the world's wealth nearly 1,000,000 tons of spelter, 100,000 tons of lead, 20,000,000 oz. of silver and 5000 tons of copper; and at the present rate is adding 200,000 tons of spelter, 20,000 tons of lead, 5,000,000 oz. of silver and 1000 tons of copper yearly.

Mr. Hoover deserves the thanks of metallurgists, especially those interested directly in ore dressing, for his work in placing, in compact form, such a large amount of important information concerning flotation processes.

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DER EISENBAU—Ein Hilfsbuch fur den Bruckenbauer und Eisenkonstrukteur. By Luigi Vianello. Second edition, enlarged and rewritten by Carl Stumpf, Konstruktions-Ingenieur an der Kgl. Technischen Hochschule zu Berlin. Munchen and Berlin: R. Oldenbourg. Cloth; 5½x8½ in.; pp. xviii + 687; 526 text illustrations. 20 marks.

This revision of Vianello's book published eight years ago is almost a new work. The reviser (after the author's death) simplified the book by omission of the matter on mathematics, etc., which is available in other handbooks, and the great amplification of the structural matter. At present, after 50 pages on Statics, the work is a full treatise on the analysis of frames and their elements (and also beams, columns, reinforced beams, etc.). There are also nearly 200 pages on details and designing, but this phase of the subject is, as usual in similar works, treated less efficiently than the analytical part. A small amount of matter on masonry walls, arches, etc., is also included.

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STATISCHE BERECHNUNG VON TUNNELMAUERWERK—Grundlagen und Anwendung auf die Wichtigsten Belastungsfälle. Von Dr.-Ing. Otto Kommerell, Kaiserl. Baurat im Reichsamt für die Verwaltung der Reichseisenbahnen. Berlin: Wilhelm Ernst & Sohn. Paper; 7x10 in.; pp. 168; 10 plates and 144 text figures. Geh. 12 M., Geb. 13.50; American price, $4.80 and $5.40, net.

A serious attempt is made in this work to provide some basis of proportioning tunnel lining, i.e., determining its profile and thickness. The factors which must be taken into account in this problem are far more varied than those which affect retaining-wall design, and may perhaps best be compared in diversity to the factors involved in determining the bearing capacity of piles. Just as in this latter problem, it will probably never be possible to secure any reasonably general or assured method of analysis. Doubtless the only hope for obtaining a working method lies in abandoning any attempt at fixed theory and in substituting specific practical assumptions. In tunnels of low and moderate depth of cover it is far more likely that useful conclusions can be drawn on the basis of certain assumptions which consider the ground to be made up of loose blocks of such or such size than on the basis of any theoretical analysis of granular materials; the latter, however, is practically always made the starting point, and in part its assumptions are used in the present work. Tunnels of very great depth of cover, those in which temperature and plasticity problems arise, are in a radically different class. At the same time the very factors which differentiate this problem from that of high-lying tunnels free the problem from many of the uncertainties and perplexities which surround the simpler case. On the whole it is to be said that the subject has received so little study and is so far from any reasonably satisfactory solution that every serious discussion of it must be welcome. For this reason, while the author's attempt is hardly more than an attempt, it will prove to be of great value and, by its interlacing of theoretical consideration and practical comparison, will engage the earnest attention and perusal of all who are concerned in tunnel work. The presentation of a series of suggested standard cross-sections makes the book of additional interest.

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MOTOR CAR CONSTRUCTION—A Practical Manual for Engineers, Students and Motor Car Owners, with Notes on Wind Resistance and Body Design. By Robert W. A. Brewer, Fellow of the Society of Engineers; author of "The Art of Aviation." New York: D. Van Nostrand Co. London: Crosby Lockwood & Son. Cloth; 5¼x8¾ in.; pp. xi + 242; 78 illustrations. $2 net.

The reader of this book must not expect that he will find here a critical comparison or, for that matter any very extended or complete comparison, of different motor cars which are to be seen either in this country or abroad. The author, when he makes comparisons at all, for the most part does so between types of apparatus, design and construction. Furthermore, the American reader must bear in mind always that while the book bears the imprint of an American publisher, it is nevertheless not an American book, but was written in England, and relates to English methods and results.

Bearing in mind these necessary limitations to the text, a study of the book shows that it is very readable, interesting and useful for those persons who may be engaged in one way or another in the construction or design of pleasure vehicles. It is not a book for the owner or for the driver. The first part of the work is largely historical and this is followed with descriptions of the ways in which the various parts of the machinery are processed, particular attention being paid to the use of jigs. Among these, stands out prominently the universal jig which is much more used in England than in this country with the greater use here of very special machines and jig fixtures.

A considerable part of the book is taken up by discussions of fundamental matters relating to gas and gasoline engines rather than to their place in automobiles. Thus we find discussions of thermal efficiency, relations of power and weight, friction and lubrication, two-cycle vs. four-cycle machines, carburation and the properties of liquid fuel, etc., and the more practical matters of valves, igniters, etc. It must not be supposed, however, that the automobile entity has been neglected, for the need of transmission gearing, brakes, spring suspensions, etc., are all taken up, both in theory and by discussion of equipment such as clutches, change gears, transmission systems, differential gears between drive wheels, control levers, parts of frames and bodies, springs, hubs, axles, etc. The final chapter of the book is given over to a discussion of the need for conforming the body shapes to some approach to stream-line form where power consumption and high speeds are important considerations.

Information on Patents for Engineers

ENGINEERS' HANDBOOK ON PATENTS—By William Macomber, of the Buffalo Bar; author of "The Fixed Law of Patents"; Lecturer on the Law of Patents, Cornell University College of Law. Boston: Little, Brown & Co. Flexible leather; 4x7 in.; pp. xv + 288; illustrated. $2.50, net.

The author of this little book is lecturer on the law of patents in the College of Law of Cornell University. His object in the book before us is not by any means to make every engineer his own patent lawyer, but to give engineers enough knowledge of the general principles of patent law and patent practice to enable them to deal intelligently with such matters regarding patents and inventions as necessarily come before them.

There is need for such a book, without doubt. Most engineers, other than those connected with manufacturing companies, frankly confess their ignorance regarding patent law and patent practice. A large proportion of the engineering profession holds a more or less hostile attitude toward patents generally. It is common to hear the opinion expressed that the patent system operates as a bar to progress. Engineers who have been in touch with the development of important inventions, however, realize that no manufacturer or capitalist could be induced to spend money on new machinery or methods which are departures from existing practice unless he had held out to him the prospect of a property right in such improvement.

Another thing which comparatively few engineers realize is that important inventions are no longer made by country blacksmiths and clergymen and amateurs. Every department of industry has now been so developed and specialized that only men who have made a thorough study of the art and are familiar with what has already been done and with the foundation principles involved can make useful contributions for improvement. The following quotation from the introductory chapter of the book presents this in admirable form:

> The time was when the American inventor was merely a clever Yankee. He could sit and whittle and whistle, and in due time produce something patentable. The clever Yankee and his day are history. Great engineering schools have come; they are everywhere, big and little. In almost any village with but a single industry may be found a trained engineer such as McCormick could not have found in 1850 to develop his reaper had he searched two continents. Any one of our five hundred colleges is turning out yearly chemists who know more of analysis and synthesis than all the chemists Goodyear could have found in 1839, when he discovered, by accident, the process of vulcanizing rubber. The inventor of today begins leagues upon leagues beyond where the New England Yankee ended. In another decade it will be nearly the whole truth to say that the American inventor is the trained engineer and chemist.
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> Since true invention begins where the known ends, it is evident that, before any man may even enter upon the larger fields of important invention, he must possess an enormous mass of complex and difficult knowledge—else he wanders aimlessly in a field unknown to him, but known to others, and invents over and over things long since invented, patented and found useful or worthless, as the case may be.
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> There is a natural tendency on the part of many engineers to rather look down upon a patent and upon the patent system as something obsolete, along with the Yankee genius who whittled trivialities out of the unknown. There is just reason for so regarding the great mass of microscopic patents which are issued * * * * but the drawing of a general conclusion therefrom is quite unwarranted.
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> * * * * *
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> The engineer may scorn a patent, scorn the idea of being an inventor; but that does not alter the fact that his client or his concern has to come in contact with the inventions and patents of others. He cannot avoid the condition or the fact; and it is his business to see that his client or his concern does not become involved in infringement or other patent troubles.

The foregoing quotation does not mean, of course, that every engineer can be or ought to be an inventor. Only a small percentage of engineers have the necessary ability to undertake original design. In fact in the great majority of engineering work what is desired is not original work, but the application to the problem in hand of well-established and standard methods of construction and operation.

As the author says, however, whether the engineer wishes to do so or not, he will more or less frequently have questions in connection with inventions and patents put up to him. It will be well worth his while, therefore, to gain at least such a rudimentary knowledge of patent law and procedure as may be obtained from this book.

Our only question concerning the book is whether, despite the author's effort to keep out legal technicalities, he has not after all made the book rather hard reading for the average engineer wholly unfamiliar with matters relating to patents. Even if this is the case, however, a large part of the book is understandable by anyone and gives just the sort of information that every engineer, or for that matter every business man, ought to have.

It is difficult to understand the reason why the publishers choose to present the book in small pocketbook form. The book is one for the library shelf and not for the pocket. Every engineer knows that these small, odd-sized books are a nuisance on library shelves.

An Uptodate Book on Gas and Oil Engines

EVOLUTION OF THE INTERNAL COMBUSTION ENGINE—By Edward Butler, Consulting Engineer; author of "Carburettors, Vaporisers and Valves." London: Charles Griffin & Co., Ltd. Philadelphia: J. B. Lippincott Co. Cloth; 6x9 in.; pp. xiv — 237; 188 text illustrations. $3, net.

The title to this book is somewhat misleading. The author himself says in the opening paragraph of his preface "the purpose of this treatise is not so much concerned with the historical development of internal-combustion engines as to present in a clear and concise form the basic principles underlying their construction and working."

It will be understood, therefore, that the book is not a historical record of the development of gas and oil engines, but is rather a discussion of the various features of gas and oil engine design which are of most interest to the inventor and designer at the present day. The following excerpts from some of the chapter headings will give some idea as to the scope of the author's treatment: Four-Stroke Cycle Engines, Methods of Scavenging, Two-Stroke Cycle Engines, Compounding Explosion Engines, Difficulties of Realizing Success on the Turbine Principle, Admission and Exhaust Valves, Ignition Methods, Starting and Reversing Engines, Cooling and Lubricating Methods.

The book is a very recent work (the preface is dated November, 1912) and the author takes pains to treat fully such recent developments as sleeve valves (best known in the United States as applied to the Knight automobile engine) and the very light high-speed engines used for aëroplanes and hydroplanes.

The illustrations have been specially made for this book, and instead of showing reproductions of shop drawings or cuts of trade catalogs, as is too often the case in technical books, typical sectional views in diagramatic style are used which show the essential features only of the parts which are being described.

One feature of the book which may be criticized is the use of very long paragraphs, sometimes exceeding a page in length, and the sparing use of side heads and center heads, which are a great convenience when a book is to be used as a reference work.

The book is strictly a technical work, intended for engineers already familiar with oil and gas engine construction and design. Other engineers will find the previous study of some more elementary work necessary to enable them to understand Mr. Butter's discussion.

This is especially the case because the author is not always clear in his explanations and is sometimes inaccurate in his use of terms. On page 65 for example, "latent heat' is used when specific heat is meant. In his discussion of the problems of design, moreover, he touches on many points on which opinions of the best experts are by no means unanimous, and the designer will in many cases not be inclined to accept the author's statement as final.

The book is, however, a valuable one, for it is just such frank discussion of the problems of design with a summary of what previous inventors and designers have done that enables us to make progress.

MAIN DRAINAGE OF LONDON—By Sir Maurice Fitzmaurice, M. Inst. C. E., Chief Engineer of the London County Council. Revised edition. London: P. S. King & Son. Paper; 8x13 in.; pp. 19; 10 plates and 6 folding plans. Post free, 1/9.

The works here described include a system of main trunk sewers, an outlet sewer on either side of the Thames, various pumping stations and two chemical precipitation plants. The latter treat the sewage and a portion of the storm water from a population of more than 5,000,000 people, amounting in 1911-12 to an average of 387,000,000 U. S. gal. per day and costing £121,523, or about $585,000 for treatment and for sludge disposal at sea, not including pumping expenses. Land for bacterial treatment has been acquired, but it is not expected that such treatment will be required for years to come, nor for more than a small part of the sewage at the outset. Brief mention is made of the promising results obtained in the summers of 1911 and 1912, with plain sedimenta-

tion instead of chemical precipitation, but with sludge removal once in 30 instead of 60 hours.

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Alternating Currents Simplified

ALTERNATING-CURRENT MACHINERY—A Practical Treatise on Alternating-current Principles and Systems, Commercial Types of Alternators, Synchronous Motors, Transformers, Converters, Induction Motors, Switchboard and Station Appliances, etc. By William Esty, S. B., M. A. Head of Department of Electrical Engineering, Lehigh University. Chicago: American School of Correspondence. Cloth; 6¼x9¾ in.; pp. xii + 467; 409 text illustrations. $3.

As one would expect, and as the author clearly states in his preface, this book has been prepared for beginners and so called practical men in order to give them a working knowledge of alternating currents. The book is written without recourse to mathematics beyond trigonometry, and this necessarily has resulted in a somewhat discursive treatment. In view of these self-imposed limitations one cannot look for extreme novelty in such a work; the material that can be presented in this way must be elementary and the requirements for clearness, balance and perspective must prevail.

The author has succeeded in maintaining the simplicity and directness of his presentation throughout the book. So many good teachers have expounded the elementary characteristics of alternating-current circuits that there would be perhaps less excuse for not having had the opening parts well adapted to the known ends; but it is not the easiest task to maintain this style and treatment throughout.

The balance of parts and the scope of treatment correspond well with the commercial importance of the topics; if there is any criticism in this regard it is in respect to a few notable omissions mentioned later.

From the properties of alternating-current circuits the reader is led through descriptions of instruments and expositions of their action. Then he is led to take up the study of the alternating-current generator and the measurement of power in polyphase circuits. Very few criticisms are to be made of the author's work here, and those relate to comparatively minor points. For instance, in discussing steam-turbine alternators he reports that the vertical-shaft construction is the usual one for the Curtis (General Electric Co.) type and one page is given to a reprint of the old arguments which have been made for that design, but he fails to note that the present tendency is decidedly toward horizontal units, owing to the limitations of the vertical type which have developed in central-station practice.

The author has a few good pages on the economical considerations which effect speed, efficiency, frequency, etc. This he follows with other good material on rating and testing. Strangely enough, under these two topics, he reprints considerable portions of the American Institute of Electrical Engineers standardization rules without noting that they have become notoriously inadequate for most modern practice, so much so in fact that the Institute has taken vigorous action for the complete revision of the code.

The author describes tests which need to be made on a generator to ascertain its voltage regulation between no load and full load, and similar operating characteristics, together with the "standard" tests for separately obtaining the individual-part losses which may be combined in the calculation of efficiency. But unfortunately he does not note that this gives no true efficiency nor does he speak of those "extra" losses, which are introduced along with the more legitimate ones, at full load—due to the changed internal conditions which are produced only by running under actual full load. Neither does he make mention of those now very important "compromise" tests which have to be made on large machines where an unlimited source of power is not available for driving under operating-load conditions. These tests, it will be recalled, are under such artificial conditions as reproduce in each part of the machine approximately full-load losses therein; they may be made by the expenditure of power only sufficient approximately to meet the sum of these various losses. The only approach to this sort of testing is the method, explained by the writer under heat tests, for making the "bucked spool" (opposed field) run with the armature short circuited. This method, however, is applicable only to generators of 12 poles or more, and completely lacks reliability for a smaller number.

The same sort of extra load losses are not mentioned under induction motors and, while with some designs they are really negligible, yet in many cases they are disturbing factors. A teacher like the author surely knows of growing shop use of "reversed-rotation" compromise tests for large induction motors and excluding mention of them in such a practical book must be attributed to his judgment of their place. But that surely is debatable as is his statement that the induction generator (driven induction motor) "has not much importance."

The practical man presumably will run up against talk of the "split-pole" converters which have come into use because of their ability to furnish from constant-potential circuits direct current at variable voltage. It will be a disappointment when such a reader fails to find here some elucidation of the action of these most interesting machines.

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Water for Industrial Uses*

Reviewed by GEORGE C. WHIPPLE*

WATER: ITS PURIFICATION AND USE IN THE INDUSTRIES—By William Wallace Christie, M. Am. Soc. C. E., Consulting Engineer; Editor, Mechanical Section of Foster's "Electrical Engineers' Pocketbook." New York: D. Van Nostrand Co. Cloth; 5x8 in.; pp. xi + 219; 79 text illustrations. $2, net.

This book treats of water and the purification of water from the standpoint of the steam producer and the manufacturer. It is an interesting compilation of various commercial methods that are now available. The illustrations are good and in some cases excellent. They give a good idea of the various devices used in the process of water softening. A few of the illustrations are colored.

In some respects the book is quite unsatisfactory and the reviewer would not be doing his duty if he failed to point out some of the defects. The most unsatisfactory chapter in the book is the first one, which treats of the impurities found in water. The analytical data given there are very inadequate and in some cases the facts are incorrect. In speaking of the solubility of oxygen in water the results are expressed in terms unfamiliar to the ordinary analyst and only a few of them are given. In the same space it would have been possible to have printed data that would have been of real use.

Elsewhere the author states that "muriatic acid saponifies the fatty soaps." What this means is a mystery.

In the section on the Use of Water in Ice Making, the author says that "natural ice is liable to contamination and should only be used for cooling the exterior vessels containing drinking fluids and never put in them unless the user is absolutely sure of its purity." This idea is contrary to the teachings of modern sanitarians, who hold that natural ice as ordinarily harvested and sold is almost entirely without danger to the public health.

On another page mention is made of the use of alum as a disinfectant, but the paragraph which follows refers to bleaching powder as a disinfectant, alum itself being merely a coagulant.

Other errors in the book might be mentioned, but these are sufficient to show the unreliability of those sections that relate to the chemistry of the processes described. It should be pointed out, also, that the tables at the end of the book on the flow of water through pipes must be used with caution, as most of them are figured with coefficients higher than are ordinarily obtained in practice after pipe has been for some time in use.

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A handsome relief map of New Jersey, which at first glance seemed to show the Delaware River flowing into Raritan Bay, proves on closer examination to represent a "Proposed Sea Level Ship Canal and Intercoastal Waterway" of the New Jersey Ship Canal Commission (Worthington M. Jacobus, secretary, Rutherford, N. J.; William F. R. Griffith, consulting engineer; C. P. Gray, mapmaker, 24 Park Place, New York City). The ship canal leaves the Delaware at or near Bordentown, not far below Trenton, and extends northeasterly to Raritan Bay, south of Staten Island. The intracoastal waterway runs from Bay Head, some distance south of Asbury Park, to Cape May. The map proper is about 10x20 in., or 11x20 in. overall. The relief was obtained by embossing heavy cardboard. A very pleasing effect has been secured by using green shading to bring out the elevations, a delicate blue for the water, and a light yellow for the land body color.

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The prices of the United States Geological Survey maps were increased on Jan. 1. Hereafter the standard topographic atlas sheets, 16½x20 in., will cost 10c. each in retail lots, or 6c. in lots of 50 or more. Besides the standard topographic maps the Survey issues a number of special prints, including maps of the United States, several individual states, Niagara

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River, Yosemite National Park, etc., lists and prices of which may be had on application to the Director of the United States Geological Survey, Washington, D. C.

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The Practical Side of Electric Transmission Line Construction

TRANSMISSION LINE CONSTRUCTION, METHODS AND COSTS—By R. A. Lundquist, E. E., Consulting Engineer. New York: McGraw-Hill Book Co. Cloth; 6x9½ in.; pp. 295; 183 text illustrations. $3, net.

It may seem like an innovation to write a work on electric transmission-line construction, which says almost nothing about the electrical features of design, and gives no method for the calculation of line spans and structures. But that is what the author has actually done here. The book is thoroughly readable, and promises to be extremely interesting to an electrical engineer, in spite of being chock full of cost data from cover to cover. Naturally, if the book shows types of construction and field methods at all comprehensively, it must be for the greater part a compilation of experience. This lessens opportunity for expressing individual opinion, but the author has taken advantage of most of the chances afforded him to criticize and suggest. As a rule, his remarks at these places are conservative. The one notable exception, if we interpret him correctly, is that he would specify wood poles according to their length, and top and butt diameters, whereas it is common practice to specify length and top diameter only. If the top diameter is specified properly, there is ordinarily no danger of poles that are available being too weak. Indeed some might be too heavy, but that would affect the appearance of the pole line to the eye, rather than its safety and utility.

The author starts off by outlining what he considers to be a proper preliminary map study of the territory through which it is desired to run a transmission line. This he would follow up, of course, with a field reconnoissance, a preliminary office location, a preliminary location survey, a study of costs of right-of-way and construction, of difficulties to be encountered, and of all such work which is preliminary to the final location of lines and determination of types of construction.

This final location is given prominence by a chapter to itself. In the following chapter the author generally compares wood, steel and reinforced-concrete towers and poles as available support for the line wires. Each of the chapters following takes up one of these types of support, steel towers and steel poles being treated separately. These sections are fully illustrated to show what practice is to be seen in various parts of the country, including methods of shop or yard construction and field erection, with plenty of cost data. It should be noted here that the author's use of cost data does not "savor of the shovel," for he has attempted the very difficult task of warning the reader of the conditions governing costs.

The section on reinforced-concrete structures will be welcomed, we believe, by construction engineers who should appreciate every attempt to collect all available information on what little work has been done in this field. The poles of the Oklahoma Gas & Electric Co. figure largely here, and are illustrated elsewhere throughout the work. Some German novelties are also discussed, and some poles described, which are perhaps not truly transmission-line structures, but which are of equal interest in this chapter.

One chapter describes some special conditions and the structures designed to meet them—river and railway crossings, outdoor switching stations, transition and branch-line poles or towers, etc. A chapter on crossarms, pins and hardware consists partly of familiar description and partly of hints, after the style of the author's introductory chapters, on expedition of distribution and placing. The criticisms of braces, guys and anchors in the chapter on guying, and the whole chapter on stringing wire, further confirm the general impressions of originality and practicability. As appendices, there are given specifications for white cedar poles, steel towers, pin-type and link-type insulators, galvanized work and creosote oil.

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THE DESIGN OF STEEL MILL BUILDINGS AND THE CALCULATION OF STRESSES IN FRAMED STRUCTURES—By Milo S. Ketchum, C. E. Dean of College of Engineering and Professor of Civil Engineering, University of Colorado; Consulting Engineer. Third edition, enlarged. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xvi + 556; 265 text illustrations and 7 folding plates; 65 tables. $4, net, postpaid.

The feature of this edition is an appendix-chapter entitled "Structural Drawings, Estimates and Designs." In substance this is a book by itself. It contains hints and instructions for the work of the structural-steel draftsman and estimator, including also a few of the more common tables used in designing, detailing and estimating. It is to be hoped that this part of the book may be ultimately so much enlarged and elaborated as to require publication as a separate work.

The book has been improved and enlarged in other parts also, though only in a minor way. The author's continued attention to the improvement of the book is apparent. Thus the third edition represents a real advance, rather than a simple new printing of the book.

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The Theory of Stream Flow

Reviewed by C. R. WEIDNER*

UNTERSUCHUNGEN UEBER DEN ZUSAMMENHANG DER ERSCHEINUNGEN IN WASSERLAEUFEN AUF GRUND HYDROMETRISCHER ERHEBUNGEN. Zur Förderung des Flussbaues und Seines Unterrichtes für Studierende und Ingenieure—By Ing. C. Krischan. Graz (Austria): "Leykam." Paper; 7x10 in.; pp. 150; 1 text illustration, and 19 plates, arranged in a portfolio 12x13 in. 15 K.

The author of this book has made a special study of the hydraulics of rivers and canals, and the book under review is the third of a series which presents the results of his researches; a fourth is to appear shortly. The plates are intended to supplement the study of the two previous volumes entitled, "Beitrag zur Pulsation des Wassers mit Rücksicht auf den Flussbau" and "Einführung in die rationelle Methode der Beobachtung im Flussbau," with a graphical representation of a large number of hydrometric observations taken in Austrian rivers and the Danube canal.

For a number of gaging stations showing widely different characteristics, curves have been drawn for each station giving the following information: Mean velocity, maximum velocity, mean surface velocity, mean velocity at the bed of the stream, area, discharge, power and impact for each of the different sections into which a cross-section of the stream has been divided; the sums of the area, discharge and power for any of these sections; and the distribution of the velocity in the entire cross-section and in vertical planes in each section. This mass of material, for several different gage heights at a station, has been plotted in one figure for the convenience of comparison, the result necessarily being a labyrinth of lines, which is extremely difficult to fathom until one becomes accustomed to the task.

The text explains the methods of plotting the observations, gives a thorough discussion of the results, and a theoretical and mathematical analysis of the different curves, which is interesting but not of much practical value until the intricate relation between theory and practice in the flow of water in open channels is more thoroughly developed.

The book adds considerable information of a theoretical nature to the study of stream flow and will probably be of interest to students of the subject.

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THIRTEENTH CENSUS OF THE UNITED STATES—E. Dana Durand, Director. Vol. IX. Manufactures. Reports by States, with Statistics for Principal Cities. Prepared under the supervision of William M. Steuart, Chief Statistician for Manufactures. Washington, D. C.: Bureau of the Census. Cloth; 9x12 in.; pp. 1404.

The reports of the Thirteenth Census (1910) are to appear in 11 volumes and in a one-volume Abstract which will be a condensation of both the text and tables forming the reports. Four volumes will be devoted to Population, three each to Agriculture and to Manufacturers and one to Mining. Only a small edition of the 11 volumes will be printed, "intended chiefly for libraries, institutions and special students of statistics." An edition of the Abstract will be issued for each state, containing first summaries for the whole country and then more detailed supplementary tables and text for the particular state concerned. It should be noted that state bulletins have already been published dealing separately with Population, Agriculture and Manufactures—and perhaps with Mining. The volume noted above is the first one published for the Thirteenth Census. Vol. VIII summarizes manufacturing statistics by states and gives a general analysis and discussion, while Vol. X will consist of monographs on special industries. Each of these monographs will also be published separately.

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Three paving specifications recently adopted by the American Society of Municipal Improvements (50 Union Square,

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New York City) have been printed in advance of the 1912 "Proceedings," in order that they might be available before the paving season of 1913. They are for (1) brick and (2) asphalt, adopted in September, 1911, and amended in November, 1912; and (3) creosoted wood block, adopted in November, 1912.

British Sewage Disposal

A TEXTBOOK ON SEWAGE DISPOSAL IN THE UNITED KINGDOM—By Henry Lemmoin-Cannon, P. A. S. I., Author of "The Sanitary Inspector's Guide," "Modern Sewage Disposal: A Popular Handbook." London: St. Bride's Press. Cloth; 5½x9 in.; pp. xx+320; 52 text figures. 7/6, net.

To write a book on sewage disposal seems to be a temptation which it is hard for Englishmen to resist. Every few months a new book on the subject appears which differs from most of the earlier ones only in being a little nearer uptodate, or perhaps merely in drawing upon a more recent report of the Royal Commission on Sewage Disposal.

The book before us is almost wholly a compilation and contains little of value that is not readily available in printed form. Underlying principles are given scanty consideration and some of the most important subjects listed in the chapter headings are given surprisingly little space.

Following traditional British practice, the author ranges over the whole field of night soil collection and disposal, and of sewage collection systems before he gets down to his real subject—Sewage Disposal. This done he describes the various methods of sewage treatment along familiar British lines, drawing freely on the Fifth Report of the Royal Commission on Sewage Disposal.

The following chapters, on small isolated plants, on an excreta sterilizer for hospital use, on the oxychloride process of "deodorizing and sterilizing sewage effluents" (a little over one page) and on automatic appliances are little more than highly condensed trade catalog descriptions of commercial apparatus or processes.

Particulars of some municipal installations, in tabular and in text form, are given. A topic not usually treated in such books is Sewage Disposal for Troops in the Field (4 pp.), but this contains little except Field Service Regulations issued by the British War Office.

The last hundred pages consist of a series of appendices in which are summarized (1) the requirements of the three Local Government Boards of the United Kingdom in connection with applications for loans for municipal sewerage systems or sewage disposal works; and (2) sewerage, drainage and sewage-disposal legislation by the British parliament, with notes on judicial interpretations.

Many of the illustrations are poor reproductions of trade catalog cuts and the lettering on some of the line drawings can be read with difficulty. In fact, the reader is advised, by means of a foot note, that "A magnifying glass will be found useful in studying most of the illustrations in this book."

The book will be found useful to those who possess none of the other and comparatively recent British books of the general type of this one, provided only a general review of British practice is needed.

NEW YORK STATE FACTORY INVESTIGATING COMMISSION—Preliminary Report, 1912. Three volumes. Albany, N. Y.: Pub. Doc. Cloth; 6x9 in.; pp. 837, 986 and 1000, respectively.

After the fire in the Harris & Blanck Co.'s shirtwaist factory in the Asch Building in New York City two years ago, when so many of the workers lost their lives, the Legislature of the State of New York appointed a commission to look into the conditions under which manufacturing is carried on in cities of the first and second class in that state. This commission has now been at work some two years, the last year, however, under a continuation appropriation, and the report of the first year's work has just been issued in three volumes. The meat of the report is contained in the first volume, the latter two being devoted entirely to the stenographer's report of testimony. This first volume should be of great interest to those engineers who are concerned with the design and operation of factories, although the report in general is of greater sociological than enginering importances.

The first volume contains, first, a general sanitary investigation of existing conditions in factories and workshops, submitted by Dr. Price, and a chapter on the fire hazard submitted by H. F. J. Porter, these two gentlemen being the experts employed by the commission. Further, the report contains special investigations on bakeries, woman workers, occupational diseases, home work, and an industrial survey of a selected area in New York City, together with briefs submitted on fire protection by various experts, and on factory inspection by other experts. The recommendations of the commission in regard to future necessary laws are also included.

MAGNETO AND ELECTRIC IGNITION—By W. Hibbert, Head of the Physics and Electrical Engineering Departments, Polytechnic Institute, London. London: Whittaker & Co. [New York: The Macmillan Co.] Cloth; 4¼x6¾ in.; pp. 154; 90 test illustrations. 70 cts., net.

This is the third book on electric ignition for internal combustion motors, to come to our notice very recently. In general, it covers about the same ground as the recent American book by F. R. Jones ("Electric Ignition," reviewed in Engineering News, May 16, 1912), but in much more condensed shape and from a British viewpoint. This volume is about the same size as "Primary Battery Ignition" by C. Wadsworth, reviewed in these columns Dec. 12, 1912, but it is far more comprehensive.

At the outset the author explains some electrical concepts in accordance with the old "fluid" theory of electricity though couched in terms of "corpuscles," "ions," etc., to accord with the later but closely allied "electron" theory. The construction of different magneto machines is shown in much detail, together with sections on faults, gearing and timing arrangements, etc. This fills some 60% of the text, the rest taking up battery and combination schemes. The make-up of "dry" (primary) and storage cells is briefly outlined and accompanied by items on troubles, circuits, induction coils and contact devices. The recent schemes combining a generator (convertible into a motor), and storage battery for an ignition, lighting and starting system are only briefly noted. The illustrations are numerous and many are of the catalog variety; the original ones, however, are still less pleasing to the fastidious eye though quite useful.

EXPERIMENTAL WIRELESS STATIONS, Their Theory, Design, Construction and Operation—A complete account of sharply turned modern wireless installations for experimental purposes, which comply with the new wireless law. By Philip E. Edelman, author of "Inventions and Patents," "Simple Experiments in Chemistry," "An Experimental Quenched Arc System," "How to Comply with the New Wireless Law." Minneapolis, Minn.: Published by the author, at 2432 Lyndale Ave. South. Cloth; 5¼x8 in.; pp. 220; 80 illustrations. $2.

An equal amount of information might have been given to advantage in less space. The facts stated are accurate, but the arrangement is poor and the text displays the common fault of jumping too quickly to the practical points without a sufficient preliminary treatment of the fundamental theory.

In spite of the apparent lack of any definite plan in the arrangement of the text, the book certainly contains a large amount of useful practical information on wireless apparatus and methods. The author definitely states that he is aiming to supply information for experimenters whose previous knowledge of the subject is limited, and his language is correspondingly non-technical. A little simple mathematics is used in showing approximate methods for calculating inductances, capacities and wave-lengths, and a large number of illustrations are provided. The conclusion contains some advice on the subject of patents.

Beginning with January, 1913, the American Institute of Architects has substituted for its regular monthly Proceedings, a publication similar to the Proceedings of other technical societies, a magazine entitled The Journal of the American Institute of Architects under the editorship of Mr. D. Knickerbacker Boyd, who is chairman of the Committee on Public Information of the Institute. This publication is intended to embody the regular society announcements, and, according to the preface in the first number, to afford to the members a frequent and intimate interchange of authentic news items relating to the progress of development in the field of architecture. The first two numbers which have appeared are most pleasing typographically.

A Gasoline Engine Trouble Chart, 22x36 in., has been published (Norman W. Henley Publishing Co., New York City; price, 25c.), showing a sectional elevation of a typical four-cylinder, four-cycle gasoline engine of automobile type. The different parts of the machine are lettered on the drawing, and at the sides of the chart are tables which should assist the amateur, or beginner, in the cure of lost power, heating, noise and irregular operation; different columns show the parts affected, tne ultimate nature of the trouble, the identifying symptom, and the remedy.